

11 DAZZLING PHOTOS FROM LA PALMA • SOLAR-FILTERED IMAGES

Astronomy

CMG 08070

AMERICA'S BEST-SELLING ASTRONOMY MAGAZINE

January 2001 • \$4.50

U.K. £2.70

Can. \$6.50

Our Essential Sun

Free Solar Glasses
to Watch an
Eclipse

The Past and
Future of
Cosmic Rays

How Astronomers
Put Military
Technology to Work

astronomy.com



MAD LX90

**Now you can
buy the telescope
of a lifetime at a price
you probably never
thought possible.**

The Meade 8" LX90, with diffraction-limited Meade optics in an Autostar™ computer-controlled telescope system, includes capabilities not available on other brands of 8" Schmidt-Cassegrains costing hundreds of dollars more. And, at \$1695, the 8" LX90 — with more than twice the light-gathering power — is priced only a few hundred dollars more than competing 5" Schmidt-Cassegrains!

Advanced capability incorporating the optical system and coatings of the 8" LX200, and with 5 arc-minute pointing precision in the GO TO mode. An instrument fully qualified for long-exposure CCD imaging and astrophotography as well as for other advanced photo-visual applications.

Special LX90 features include: (a) a die-cast aluminum *double-time* fork mount that rigidly supports the optical tube in all sky orientations; (b) *worm gears* of 4.9"-diameter on both telescope axes for smooth sidereal-rate tracking of celestial objects as well as precise guiding corrections during long-exposure imaging; (c) a rigid chromed-steel variable-height field tripod — the same tripod provided with Meade LX200 models.

Autostar Computer Controller: The LX90's standard-equipment Autostar controller connects to the telescope's control panel and permits an incredible array of telescope features:

- **Automatic GO TO capability** at 6.5°/sec on both axes, simultaneously, to 30,223 database objects, including:
13,235 deep-sky objects — the complete Messier, Caldwell, IC, and NGC catalogs; 16,888 stars sorted by name and SAO catalog numbers; 8 major planets from Mercury to Pluto; the Moon; 26 asteroids; 15 comets; 50 Earth satellites; plus 200 memory locations for user-defined objects.
- **Automatic GO TO capability** to any object of known R.A. and Declination. Plus hundreds of special event menus, guided tours, utility functions, and telescope status options.
- **Nine selectable slew speeds:** 6.5°/sec, 3°/sec, and 1.5°/sec, as well as 128x, 64x, 16x, 8x, 2x, and 1x sidereal.
- **Control of the telescope** through your personal computer. (Requires optional #505 Connector Cable Set.)
- **Fast alignment of the telescope** in either equatorial or altazimuth modes using any of three alignment functions, including the Meade-proprietary Easy Align*.
- **Unlike the hand controllers** included with competing 5" and 8" SCT's, *Autostar is fully upgradeable over the Internet:* the observer can add the positions of new comets, update the positions of Earth satellites, even add new software as it becomes available.

Cordless Operation: The LX 90 is powered at 12 volts DC provided by (user-supplied) C-cell batteries. Alternately, the telescope may be powered from an automobile cigarette lighter plug or from a standard 115vAC home outlet, using optionally available power cords.

* Patent pending.

SPECIFICATIONS: 8" LX90 — Each complete telescope includes 8" f/10 Schmidt-Cassegrain optical tube assembly with EMC super multi-coatings; double-time fork mount with dual-axis 4.9" worm gears and control panel; electric slow-motion controls on both axes; Autostar hand controller with digital readout display, 9-speed drive controls on both axes, and GO TO controller; 30,223-object onboard celestial software library; internal battery port accepts 8 (user-supplied) C-cells (optional 25 ft. cords permit powering from either 12vDC auto cigarette lighter plug or from 115vAC home outlet); 8 x 50mm viewfinder; 1.25" diagonal prism; Series 4000 Super Plössl 26mm eyepiece; standard field tripod; operating instructions. **\$1695.** Packing & shipping in the 48 states: \$95.

**Meade 8" LX90
Schmidt-Cassegrain
Telescope.
Complete as shown:
\$1695**

AUTHORIZED MAIL-ORDER DEALERS

ASTRONOMICS, Norman, OK.
Orders: 800-422-7876; Info.: 405-364-0858.

FOCUS CAMERA, Brooklyn, NY.
Orders: 800-221-0828; Info.: 718-436-6262.

LUMICON, Livermore, CA.
Orders: 800-767-9576; Info.: 925-447-9570.

OCEANSIDE PHOTO & TELESCOPE, Oceanside, CA.
Orders & Information: 800-483-6287.

POCONO MOUNTAIN OPTICS, Moscow, PA.
Orders: 800-569-4323; Info.: 570-842-1500.

RIVERS CAMERA, Dover, NH.
Orders: 800-245-7963; Info.: 603-742-4888.

SHUTAN CAMERA & VIDEO, Chicago, IL.
Orders & Info.: 800-621-2248; IL: 847-367-4600.

EFSTONSCIENCE, Toronto, Ontario, Canada
Orders & Information: 416-787-4581.

KHAN SCOPE CENTRE, Toronto, Ontario, Canada
Orders & Information: 416-783-4140.

LX200

The largest-selling serious telescopes in the world are now available at the most affordable prices ever!

With their large object databases, fast slewing speeds, and uncanny pointing precision, Meade LX200's are recommended for those amateurs who intend an extensive program of CCD imaging, astrophotography, or deep-space observing. Compare a Meade LX200 feature-for-feature with competing single-tine-fork, spur-gear-driven, GO TO Schmidt-Cassegrains:

Superb Optics: With oversize primary mirrors for greater full-field illumination, LX200 diffraction-limited imaging capabilities are a legend in the industry; we regularly receive reports stating that optical performance approaches that of a fine *ED* apochromatic lens.

Automatic GO TO Capability: Competing 8" Schmidt-Cassegrains claim to place objects "somewhere in the field of view"; Meade LX200's place objects **dead-center** in the field of view, first time, every time, to a pointing precision of **2 arc-minutes or better**, or, with Meade exclusive High Precision Pointing, to a precision of **one arc-minute or better**. *Meade LX200's are the only commercial telescopes ever manufactured that automatically GO TO any input R.A. and Dec., or to any object in the onboard database, to these levels of precision.*

Database of 64,359 Objects, a database *more than three times larger* than competing GO TO telescopes.

Permanently-Programmable Smart Drive™ routinely achieves 5 arc-sec. periodic error, an observatory standard. Other brands of GO TO 8" SCT's decline to state their periodic error and do not offer any programmable error-corrector.

9-Speed Dual-Axis Electronics: Electronics that cover every contingency of telescope positioning — from 2x photo-guide, to 32x image centering, to 8°/sec. slewing across the sky, plus 6 other dual-axis drive speeds in between.

Rigid LX200 Dual-Tine Fork Mountings with Dual 5.75" Worm Gears are the choice of advanced observers, CCD imagers, and astro-

photographers for their most sensitive applications. Competing spur-gear-driven single-tine forks can not approach the strength, rigidity, and drive-rate precision built into every Meade LX200 mounting.

Full Long-Exposure Capability: Competing 8" GO TO telescopes describe their capability to take short-exposure "planetary and terrestrial photos," without reference to any long-exposure capabilities. Meade LX200's have been the instruments of choice in **thousands** of the most detailed long-exposure images ever taken by amateur astronomers.

Strong Field Tripods: Unlike the thin, extruded aluminum tripods of competing models, every LX200 includes a fully adjustable steel field tripod perfectly suited to the sub-arc-second resolution of the telescope's optics.

SPECIFICATIONS: 7", 8", 10", and 12" LX200's — Each complete telescope includes 8" or 10" (f/6.3 or f/10) or 12" f/10 Schmidt-Cassegrain or 7" f/15 Maksutov-Cassegrain optical tube assembly with EMC super multi-coatings; heavy-duty fork mount with 4" polar ball bearing, dual-axis 5.75" worm gears, and multi-function control panel; manual and electric slow-motion controls on both axes; keypad hand controller with digital readout display, permanently programmable Smart Drive, 9-speed drive controls on both axes (7-speed on 12"), High-Precision Pointing, and GO TO controller; 64,359-object onboard celestial software library; 25 ft. power cord and adapter for telescope operation from 115v.AC (optional #1812 Electronic DC Adapter allows for field powering directly from an automobile cigarette lighter plug); 8 x 50mm viewfinder; 1.25" diagonal prism (7", 8", 10") or 2" diagonal mirror with 1.25" adapter (12"); Series 4000 Super Plössl 26mm eyepiece; standard field tripod (7", 8", 10") or giant field tripod (12"); operating instructions.

8" LX200 Schmidt-Cassegrain \$2295
10" LX200 Schmidt-Cassegrain 2695
12" LX200 Schmidt-Cassegrain 3995

7" LX200 Maksutov-Cassegrain 2795

Packing and shipping in the 48 states: 8"—\$105; 10"—\$145; 12"—\$215; 7"—\$125.

Prices shown are suggested U.S. mail-order retail prices.

**Meade 8" LX200
Schmidt-Cassegrain
Telescope.
Complete as shown:
\$2295**



New 2000-2001 126-page
Meade General Catalog!
Call, write or fax for your free
copy.



ADVANCED PRODUCTS DIVISION

Meade Instruments Corporation

World's Leading Manufacturer of Astronomical Telescopes for the Serious Amateur

6001 Oak Canyon, Irvine, California 92618 ■ (949) 451-1450

FAX: (949) 451-1460 ■ www.meade.com

© 2000



Astronomy®

January 2001 • Vol. 29, No. 1

COVER PHOTO: SOHO

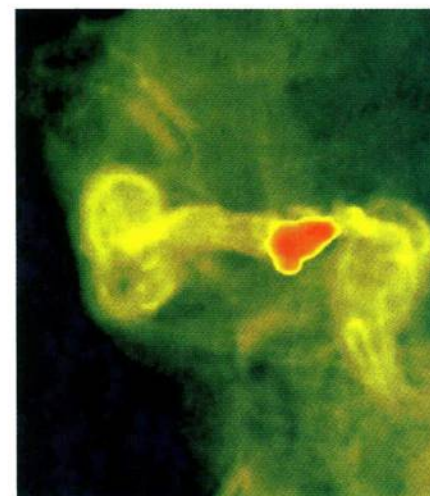
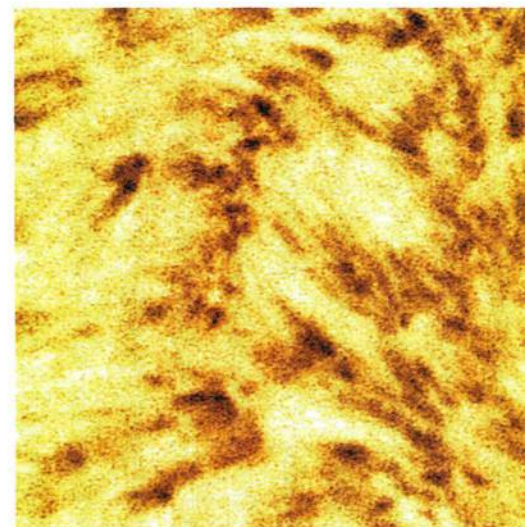
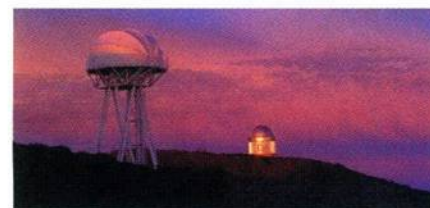


FEATURES

- 36 Discovering Cosmic Rays**
Powerful and mysterious, cosmic rays still baffle astronomers nearly 80 years after they were first detected. *James Trefil*
- 42 Showered in Mystery**
Astronomers hope a new observatory will unlock the key to the origin of the most energetic cosmic rays. *Ivan Semeniuk*
- 48 Military Magic Boosts Astronomy**
Both astronomy and space exploration are growing by leaps and bounds, thanks in no small part to a trickle-down effect from military technology. *James Oberg*
- 56 "We Are All Star Stuff"**
Nearly all the elements essential for life were forged in the nuclear furnaces at the centers of stars and then scattered into interstellar space. *Neil F. Comins*
- 62 Destination: La Palma**
The Canary Islands may be a favored vacation spot for Europeans, but astronomers find the clear, steady air on one volcanic peak to be perfect for observing. *Kelly Kizer Whitt*
- 80 Celestial Portraits: Cassiopeia**
With bright nebulae, rich star clusters, and nearby galaxies, the queen's realm has everything it takes to satisfy backyard observers. *Tom Polakis*
- 90 Sunsational Photography**
Slap a hydrogen-alpha filter on your telescope and you'll see solar activity like you never have before. *Jean Dragesco*
- COVER**
- 98 Embracing the Sun**
December 25, 2000, marks the last solar eclipse of the 20th century. With our guide and free solar glasses, you won't miss out on any of the fun. *Richard Talcott*

62 Dazzling Photos from La Palma

Nik Szymanek and Ian King



36 Past and Future of Cosmic Rays

Very Large Array



80 Cassiopeia

From *The Glorious Constellations*,
© 1991; Harry N. Abrams, Inc.



DEPARTMENTS



56 We Are All Star Stuff

John Chumack

6 Behind the Scenes

- Western Skygazing

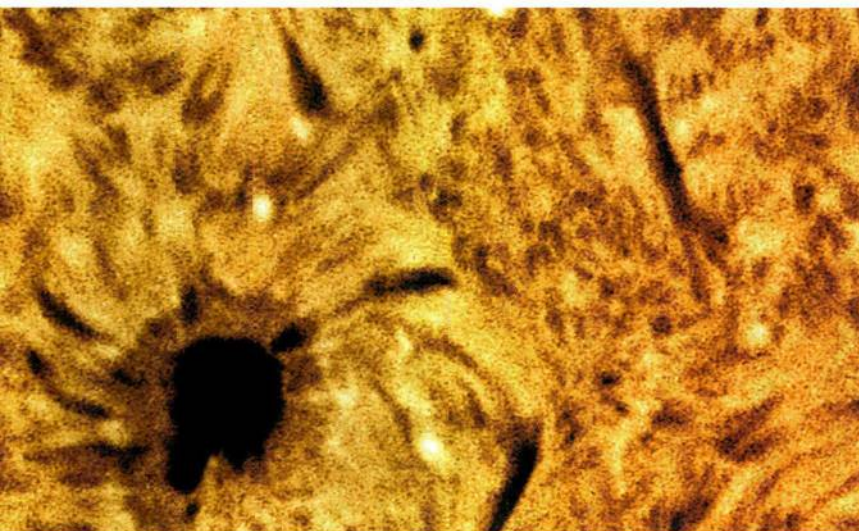
16 Talking Back

22 AstroNews

- NASA Shelves Pluto Mission
- TRACE Turns Up the Heat
- Imaging a Black Hole
- Cassini Shoots Jupiter
- Another Record-Setting Burst
- Hubble Captures the Veil
- A New Year's Resolution

90 Solar-Filtered Images

Jean Dragesco



42 Showered in Mystery

Brad Whitmore (STScI) and NASA



68 Sky Show

- With the moon being eclipsed in Europe, Africa, and Asia, and Venus at its best in the evening, the new year gets off to a rousing start.

Martin Ratcliffe and Alister Ling

86 Ask Astro

102 Strange Universe

108 Star Stuff

Products

- Celestial Harvest: Showpieces of the Heavens for Telescope Viewing and Contemplation
- The Amateur Scientist: The Complete 20th Century Collection
- LaserMate Collimator

Books

- *Stardust: Supernovae and Life — The Cosmic Connection*
- *Science and Technology Encyclopedia*
- *E=mc²: A Biography of the World's Most Famous Equation*

120 Looking Ahead

129 Hot Shots

- Shooting the Moon

134 Ultimate Exposure

135 Advertiser Index



98 Our Essential Sun

Jay Pasachoff

Western Skygazing



We arrived in Denver, Colorado, at about 10 P.M. on Thursday before the *Astronomy* magazine Sky Show. It was snowing — an early autumn snow, but not unheard of. Sometimes Denver is hit by a blizzard in September. Still, for a star party this wasn't good.

A few local meteorologists predicted a quick clearing for Friday, when our party was to be staged at a nearby reservoir. But the snow continued on and off all day Friday and by noon we called on everyone to post our new date — Saturday, October 7.

Volunteers from the Denver Astronomical Society and from Colorado Springs began to show up at the Aurora Reservoir Park at about 2 P.M. on Saturday. Beneath a heavy layer of clouds, telescopes were assembled. Scott Roberts from Meade Instruments, our major sponsor, showed up and began setting up his booth just as if everything might go well. The clouds looked thick, but at least some of our exhibitors had indoor space. Outdoors it was 28° F. As the afternoon wore on, the clouds thinned and hopes rose.

We began to notice the sky fill with a kind of music. It was a soothing warble, something like the one that African singers made to back Paul Simon on *Graceland*. We realized quickly that this was the sound of strange and unknown birds. One of our volunteer telescope operators recognized it as the music of sandhill cranes. These 5-foot-tall birds migrate through Denver south along the Platte River for 24 hours each year.

The birds gradually became visible out of the clouds in a long unfurling ribbon that curled back on itself. About a hundred strong, this flock had none of the fine military precision of geese but instead followed one another closely in lines that seemed to change pattern on a whim. Then the birds disappeared into southwestern clouds, their songs still audible. New flocks replaced the disappearing ones almost continuously.

Suddenly, as if a reward for a charmed life or a balm to major disappointment, the huge birds began to land at the edge of the reservoir. We already had our binoculars in hand, but as they landed we began to point the big scopes at them. By 6 P.M. our guests began to straggle into the star party; we were glad to invite them to look at the cranes. In all, several thousand sandhill cranes must have flown in and out of sight, hundreds of them stopping along the reservoir for a brief rest.

Among our guests, we had travelers from Detroit and a guy named Michael who flew in from Indiana for the party. Though they missed skygazing, no one went away disgruntled. Many seemed mesmerized by the

crane migration. Sometimes a natural disaster changes one kind of party into another.

After dark, the sweet sad sound of sandhill cranes continued drawing volunteers and guests outside into the cold cloudy night. It was a natural wonder — though different from the one we had expected.



Marie Reed/Natural History Photography



Peter Sutter

TOP: We saw no stars in Denver, only sandhill cranes. **BOTTOM:** Scott Roberts (right) of Meade Instruments awards an ETX 90 to Ruben Jimenez and his daughter, Dianna, newcomers to astronomy.

EDITORIAL STAFF

EDITOR

Bonnie Bilyeu Gordon

MANAGING EDITOR

David J. Eicher

SENIOR EDITORS

Rex Graham, Richard Talcott

ASSOCIATE EDITORS

Carol Ryback, William Schomaker

PHOTO EDITOR

Kelly Kizer Whitt

EDITORIAL ASSOCIATE

Terry Williams Conley

EDITORIAL ASSISTANT

Julie Sherwin

CONTRIBUTING EDITORS

Robert Irion, Ray Jayawardhana, Patricia Kurtz, Beth Livermore, John Shibley, Tom Yulsman

ART STAFF

ART DIRECTOR

Carole Ross

ASSISTANT ART DIRECTOR

Thomas Ford

GRAPHIC ARTIST

Beth Wesselhoff

ILLUSTRATOR

Elisabeth Rowan

PRODUCTION COORDINATOR

Helene Tsigistras

EDITORIAL ADVISORY BOARD

Buzz Aldrin, Marcia Bartusiak, K.C. Cole, Timothy Ferris, Adam Frank, Paul Hodge, John S. Gallagher III, Anne L. Kinney, Edward Kolb, Alan Lightman, Stephen P. Maran, Boyce Rensberger, James Trefil

ASTRONOMY.COM EDITOR

Andrea Gianopoulos

K Astronomy HOME PAGE 
<http://www.astronomy.com>

ASTRONOMY (ISSN 0091-6358, USPS 531-350) is published monthly by Kalmbach Publishing Co., 21027 Crossroads Circle, P.O. Box 1612, Waukesha, WI 53187. Editorial phone: (262) 796-8776; advertising: (888) 558-1544; customer service & sales: 800-533-6644; outside the U.S. and Canada: 262-796-8776, ext. 421, Monday through Friday, 8:30 A.M. to 5 P.M. CT. Fax: (262) 796-1615; E-mail: customerservice@kalmbach.com. Please include your name, mailing address, and telephone number with any correspondence. Copyright © 2000 Kalmbach Publishing Co., all rights reserved. Material in this publication may not be reproduced in any form without permission. Periodicals postage paid at Waukesha, WI, and additional offices. Printed in the U.S.A. Allow 6 to 8 weeks for new subscriptions and address changes. Subscription rate: single copy: \$4.50; 1 year \$39.95, 2 years (24 issues) \$74.95, 3 years (36 issues) \$106.95; Canadian & foreign: 1 year \$50, 2 years \$95, 3 years \$137. Payable in U.S. funds drawn on U.S. Banks. (Canadian price includes GST.) Expedited Delivery Service Surcharges: Domestic 1st Class \$30 per year, Canadian air \$30 per year, Foreign air, \$60 per year. BN 12271 3209 RT. Canada Post Publication Agreement Number 545-775. Not responsible for unsolicited materials. POSTMASTER: Send address changes to *ASTRONOMY*, 21027 Crossroads Circle, P.O. Box 1612, Waukesha, WI 53187-1612.

8" LX10 8" LX10 DELUXE

The optical performance of a Meade 8" LX200 Schmidt-Cassegrain...for only **\$995!**

8" LX10: For the serious amateur astronomer on a more limited budget, or for the more casual observer who nonetheless demands the very finest in optical performance, the Meade 8" LX10 satisfies every requirement. *Standard equipment includes:*

Super-Multi-Coated Optical System: The *exact same* multi-coated 8" Schmidt-Cassegrain optical tube assembly as the more expensive Meade 8" LX200. **Series 4000 SP26mm eyepiece:** Complements the exquisite imaging of Meade 8" SC optics. **Equatorial Fork Mounting:** The relatively light weight, but very stable, LX10 fork mounting provides all of the rigidity required for sensitive high-power applications of the telescope, or for photographic or CCD imaging. **Cordless, DC-Powered Electronic Motor Drive:** With electronically-regulated DC servo motor for automatic *sidereal-rate* tracking; powered by four AA-size batteries that fit conveniently into the telescope's control panel; battery life is in excess of 50 hours. **Worm-Gear System:** The LX10's 5.75"-diameter worm gear produces extremely smooth, regular motion in R.A., with low periodic error — a periodic error that permits such advanced capabilities as long-exposure astrophotography or CCD imaging. **Hand Controller:** Essential for micro-guiding the telescope during long-exposure astrophotography, the LX10's pushbutton hand controller enables precise corrections in R.A. at 2x speed. With the optional electric Declination motor added to the telescope, the hand controller is functional at 2x speeds on both telescope axes.

SPECIFICATIONS: 8" Model LX10 — Includes 8" Schmidt-Cassegrain optical tube assembly with EMC super multi-coatings (D = 203mm; F = 2000mm, f/10); fork mount with setting circles, manual slow-motion controls, and locks on both axes; 5.75" LX worm gear reduction system; sidereal-rate electronically-regulated DC servo motor drive; 4-pushbutton hand controller for 2x speed corrections in R.A.; battery compartment accepting four (user-supplied) AA-size batteries (telescope may also be powered from an auto cigarette lighter plug, using optional 25 ft. cord); 6 x 30mm viewfinder; eyepiece-holder and diagonal prism (1.25"); SP26mm multi-coated eyepiece; standard equatorial wedge with elevation scale, fine elevation control, and 360° azimuth orientation capability; complete operating instructions. **\$995.** (+ \$65 packing & shipping in the 48 states)

8" LX10 Deluxe: At only \$1149 the 8" LX10 Deluxe includes (a) the large-aperture Meade #544 8 x 50mm viewfinder (in place of the standard 6 x 30mm finder); (b) the LX10 Electric Declination Motor System, permitting dual-axis guiding corrections at 2x speed; and (c) Meade Epoch 2000 Jr. Sky Software with 10,000-object database — all at substantially lower cost than if the respective accessories were purchased separately.

SPECIFICATIONS: 8" Model LX10 Deluxe — Identical in all specifications to 8" Model LX10, above, but with Electric Declination Motor System provided as standard equipment, permitting dual-axis corrections at 2x speed; Meade #544 8 x 50mm achromatic viewfinder in place of 6 x 30mm viewfinder; and Meade Epoch 2000 Jr. Sky Software with 10,000-object database.

\$1149. (+ \$65 packing & shipping in the 48 states)

Field Tripod for LX10 or LX10 Deluxe 195.

Electric Declination Motor System for LX10. 95.

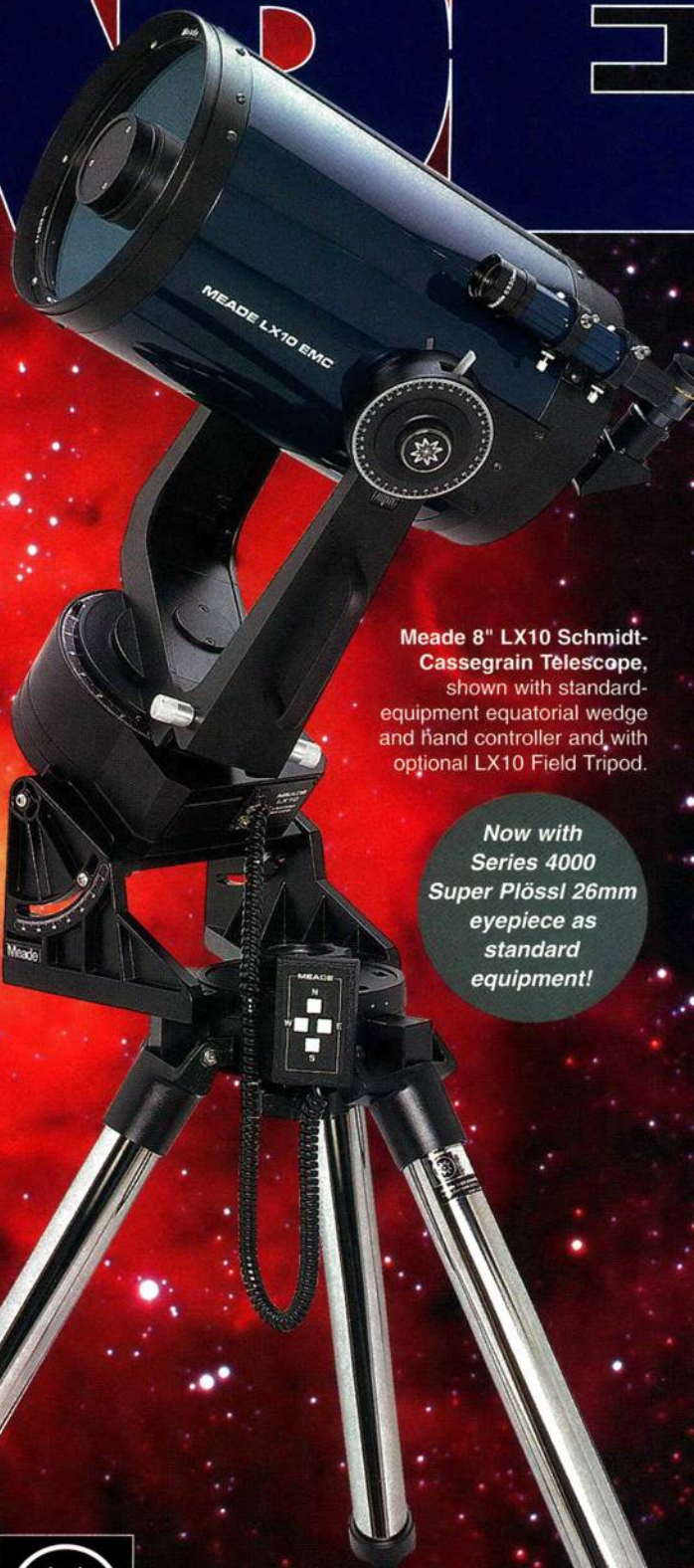
#2014 Magellan I Telescope Computer System

for LX10 or LX10 Deluxe,

with 12,218-object database **375.**

Prices shown are suggested U.S. mail-order prices.

© 2000



Meade 8" LX10 Schmidt-Cassegrain Telescope, shown with standard equipment equatorial wedge and hand controller and with optional LX10 Field Tripod.

Now with
Series 4000
Super Plössl 26mm
eyepiece as
standard
equipment!



ADVANCED PRODUCTS DIVISION

Meade Instruments Corporation

The largest-selling telescopes in the world. ■ A NASDAQ® company.

6001 Oak Canyon, Irvine, California 92618 ■ (949) 451-1450

FAX: (949) 451-1460 ■ www.meade.com

© 2000

New!

Now you
can join the
ETX revolution
for as little as
\$299, complete!

MEADE ETX-60AT • ETX-70AT

Let Meade high-resolution ETX optics and standard-equipment Autostar controller take you on an automated guided tour of the Solar System, the Galaxy, and beyond. Now even the most novice amateur astronomer can locate and explore the planets, asteroids, and comets, as well as nebulae, star clusters, galaxies, and hundreds of other deep-space objects, at the push of a button.

Fork Mount with Dual-Axis Drive System: In conjunction with the Autostar hand controller, precision worm gear systems on each axis permit smooth pushbutton motions of the telescope, as well as sidereal-rate tracking in the altazimuth mode.

Standard-Equipment #494 Autostar™ Controller: The #494 Autostar includes most of the same features as the more advanced #497 Autostar available for larger Meade ETX models (*facing page*).

- **Automatic dual-axis GO TO function at 4.5°/sec.** to any of more than 1450 database objects, including the complete Messier and Caldwell deep-space object catalogs, the major planets from Mercury to Neptune, 26 asteroids, 15 periodic comets, and more.
- **Select any of Autostar's database objects, or any object of known R.A. and Dec, press GO TO** and the telescope automatically slews to the object, placing it in the telescopic field of view.
- **Digital readouts** of telescope position, continuously in R.A. and Dec.
- **9-speed Dual-Axis Operation:** Pushbutton control of the telescope on both axes, simultaneously, at any speed from 2x sidereal to 4.5°/sec., plus sidereal-rate tracking.

High-Resolution Achromatic Objective Lenses: ETX 60mm and 70mm models include multi-coated, air-spaced achromatic lenses of exclusive Meade design; each lens yields razor-sharp images of astronomical and terrestrial subjects.

Flip-Mirror System: Flip the internal optical flat mirror "up" for 90° observing; flip the mirror "down" for terrestrial observing with the optional #933 45° Erecting Prism or for photography with the optional #64ST Photo Adapter.

Cordless Operation: The dual-axis drive of Meade ETX-60AT and ETX-70AT models operates for over 20 hours in the field from six AA-size (user-supplied) batteries which store neatly inside the drive base.



ETX-70AT: \$349,
complete with #494
Autostar Controller

ETX-60AT: \$299,
complete with #494
Autostar Controller

SPECIFICATIONS: ETX-60AT and ETX-70AT Astro Telescopes — Each

includes achromatic refractor optical tube assembly (D = 60mm, F = 350mm, f/5.8 or D = 70mm, F = 350mm, f/5) with multi-layer optical coatings; internal flip-mirror system for either straight-through or 90° observing position; fork mount with electric slow-motion controls,

setting circles, and locks on both axes; electronic control panel; 9-speed (2x sidereal through 4.5°/sec.) dual-axis motor drive system with #494 Autostar computer controller; sidereal-rate tracking; internal battery compartment accepting six (user-supplied) AA-size batteries; MA9mm (39X) and MA25mm (14X) multi-coated eyepieces; operating instructions. **ETX-60AT — \$299** (+\$10 packing & shipping in the 48 states); **ETX-70AT — \$349** (+\$10 P & S).

OPTIONAL SYSTEMS FOR MEADE ETX TELESCOPES*

#882 Standard Field Tripod (60, 70)	\$99.00	#883 Deluxe Field Tripod (90, 125)	199.95
#827 8 x 25mm Right-Angle Viewfinder (60, 70)	49.95	#825 8 x 25mm Right-Angle Viewfinder (90)	49.95
#773 Hard Carry Case (60, 70)	59.95	#774 Hard Carry Case (90)	99.95
#933 45° Erecting Prism (60, 70)	49.95	#775 Hard Carry Case (125)	149.95
#64ST Photo Adapter (60, 70)	19.95	#932 45° Erecting Prism (90, 125)	49.95
#497 Autostar Computer Controller (90, 125)	149.00	#64 Photo Adapter (90, 125)	34.95
#880 Equatorial Table Tripod (90)	29.95	Electric Focuser #1244 (90) or #1247 (125)	119.95
#881 Equatorial Table Tripod (125)	59.95		

*see also the Meade accessory ad in this issue.

MEADE INSTRUMENTS CORPORATION The largest-selling telescopes in the world.

MEADE

ETX-90EC • ETX-125EC

ETX-90EC:
\$595, complete
with Electronic
Controller

ETX-125EC:
\$895,
complete with
Electronic
Controller

Two advanced apertures:
ETX-90EC — \$595
ETX-125EC — \$895

Meade® 3.5" and 5" ETX® models include the very latest in microprocessor-controlled capability:

Fork Mount with Dual-Axis Drive System: Each with high-torque DC motors on both telescope axes, permitting electronic operation from the standard-equipment plug-in hand controller.

Pushbutton Electronic Hand Controller: Use at any of four dual-axis speeds: 8x for image centering at high power; 32x for image centering at lower power or for pushbutton object-tracking in the altazimuth mode; 0.75°/sec for image centering in the viewfinder or for terrestrial tracking; 5°/sec for fast slewing across the sky.

Maksutov-Cassegrain Optical Systems: Manufactured at the Meade Irvine, facility, ETX diffraction-limited optics produce images so high in contrast and resolution that ETX telescopes often outperform other telescopes of larger apertures.

Flip-Mirror System: Flip the internal optical flat mirror "up" for 90° observing; flip the mirror "down" for terrestrial observing with the optional #932 45° Erecting Prism or for photography with the optional #64 Photo Adapter.

Cordless Operation: The dual-axis drive system operates for more than 40 hours from eight (user-supplied) AA batteries which store neatly inside the drive base.

Optional #497 Autostar™ Capability: Plug in the optional Meade #497 Autostar computer controller for LX200-type operation, including:

- **Automatic dual-axis GO TO function at 5°/sec** to any of more than 14,000 database objects, including deep-space objects (galaxies, diffuse nebulae, planetary nebulae, star clusters); the 8 major planets from Mercury to Pluto; 26 of the brightest asteroids; 15 periodic comets; and more.
- Select any of Autostar's database objects, or any object of known R.A. and Dec, press **GO TO** and the telescope automatically slews to the object, placing it in the telescopic field.
- **Digital readouts** of telescope position, continuously in R.A. and Dec.
- **9-Speed Dual-Axis Operation:** Pushbutton control of the telescope on both axes, simultaneously, at any speed from 2x sidereal to 5°/sec., plus sidereal-rate tracking.



SPECIFICATIONS: ETX 90EC and ETX- 125EC Astro Telescopes —

Each includes Maksutov-Cassegrain optical tube assembly (D = 90mm, F = 1250mm, f/13.8 or D = 127mm, F = 1900mm, f/15) with EMC super multi-coatings; internal flip-mirror system for either

straight-through or 90° observing position; fork mount with electric slow-motion controls, setting circles and locks on both axes; electronic control panel; 4-speed (8x, 32x, 0.75°/sec, 5°/sec) dual-axis motor drive system with hand controller; sidereal-rate tracking in equatorial mode with optional table tripod or deluxe field tripod; internal battery compartment accepting eight (user-supplied) AA-size batteries; 8 x 21mm erect-image (ETX-90EC) or 8 x 25mm right-angle (ETX-125EC) viewfinder; Series 4000 Super Plössl 26mm eyepiece (1.25"); instructions. **ETX-90EC — \$595** (+ \$20 packing & shipping in the 48 states); **ETX-125EC — \$895** (+ \$30 P & S).

AUTHORIZED U.S. AND CANADA MAIL-ORDER DEALERS

ASTRONOMICS, Norman, OK.
Orders: 800-422-7876; Info.: 405-364-0858.

FOCUS CAMERA, Brooklyn, NY.
Orders: 800-221-0828; Info.: 718-436-6262.

LUMICON, Livermore, CA.
Orders: 800-767-9576; Info.: 925-447-9570.

OCEANSIDE PHOTO & TELESCOPE, Oceanside, CA.
Orders & Information: 800-483-6287.

POCONO MOUNTAIN OPTICS, Moscow, PA.
Orders: 800-569-4323; Info.: 570-842-1500.

RIVERS CAMERA, Dover, NH.
Orders: 800-245-7963; Info.: 603-742-4888.

SHUTAN CAMERA & VIDEO, Chicago, IL.
Orders & Info.: 800-621-2248; IL: 847-367-4600.

KHAN SCOPE CENTRE, Toronto, Ontario.
Orders & Information: 416-783-4140.

MMAE

STARFINDER™ EQUATORIAL NEWTONIANS

**Meade Starfinder
8" Equatorial with
Motor Drive...
now only
\$599!**

Complete with giant rack-and-pinion focuser for 1.25" and 2" eyepieces, 6 x 30mm viewfinder, Super Plössl 26mm eyepiece, and premium-grade Pyrex® optical system.

Precision, heavy-duty equatorial mount with DC-powered drive system for fully automatic tracking.

Shown with optional #2011 Magellan I Computer System.

Professional-Grade Optical System: Hand-figured, parabolic primary mirror and elliptical flat secondary, both of Grade-A Pyrex glass. Optics are multi-coated and meet the theoretical limits of resolution.

Accessories and Components: Premium-grade multi-coated SP26mm eyepiece (1.25"); 6 x 30mm viewfinder with wide 7° field; strong, durable, spiral-wound optical tube with attractive white finish.

Precision Equatorial Mount: Manufactured of machined aluminum to tolerances of .001" or better, with 4"-dia. pier and die-cast tripod legs for rock-solid support of the optical tube. Moves effortlessly from object to object on precision bearing surfaces. Polar and Dec. shafts are 1" solid steel. Setting circles on both axes.

Battery-Powered Cordless Drive System: For fully automatic tracking of celestial objects. Operates over 50 hours from 6 (user-supplied) AA-batteries or from 12v. auto cigarette lighter plug, using optional 25 ft. cord.

2" Giant Focuser: Meade #77 giant rack-and-pinion focuser is included as standard equipment, with eyepiece-holders for both 1.25" and 2" eyepieces.

Starfinder Equatorial 16: Includes equatorial mounting with 1.5" steel shafts, Sealmaster ball bearings, 6" dia. pier, and 6 x AA-size battery-powered worm gear drive; 8 x 50mm viewfinder; #77 giant focuser.



Magellan I Telescope Computer System: Use the Magellan I computer to manually slew the telescope quickly to any of 12,218 database objects, or to any object of known R.A. and Dec. Specifications and object database are identical to Magellan I for Starfinder Dobsonians (see facing page).

#2011: for Meade Starfinder Equatorial 6", 8", or 10" \$295
#2012: for Meade Starfinder Equatorial 16" 295.

Magellan II Computer-Corrector: Plug the Magellan II into the control panel of your Meade Starfinder Equatorial and you have all the capabilities of the Magellan I, above, including 12,218-object database, plus a 4-speed (2x, 8x, 16x, 32x), dual-axis, drive corrector/microslewing system.

#2018: for Starfinder Equatorial 6", 8", 10" 495.
#2019: for Starfinder Equatorial 16" 595.

Packing & shipping in the 48 states: Magellan I—\$15, Magellan II—\$20.



Special Eyepiece Offer! At the time you order any Meade Starfinder Equatorial telescope, you can buy a Meade Series 4000 Super Plössl 9.7mm eyepiece **for only \$29.95!** Purchased separately, the SP9.7mm eyepiece sells for \$79.95.

Meade Starfinder Equatorial Telescopes

6" f/8	\$499	10" f/4.5	699
8" f/6	599	16" f/4.5	2695

Packing & UPS Shipping Charges to any address in the 48 states: 6"—\$65; 8"—\$75; 10"—\$90; 16"—\$55 packing, shipped truck freight collect.

To Order any Starfinder model: contact your authorized Meade Advanced Products Dealer. Prices shown are suggested U.S.A. mail-order retail prices.



New 120-page
2000 Meade General
Catalog!

Write, call, or fax
Meade Instruments
for your free copy.



ADVANCED PRODUCTS DIVISION

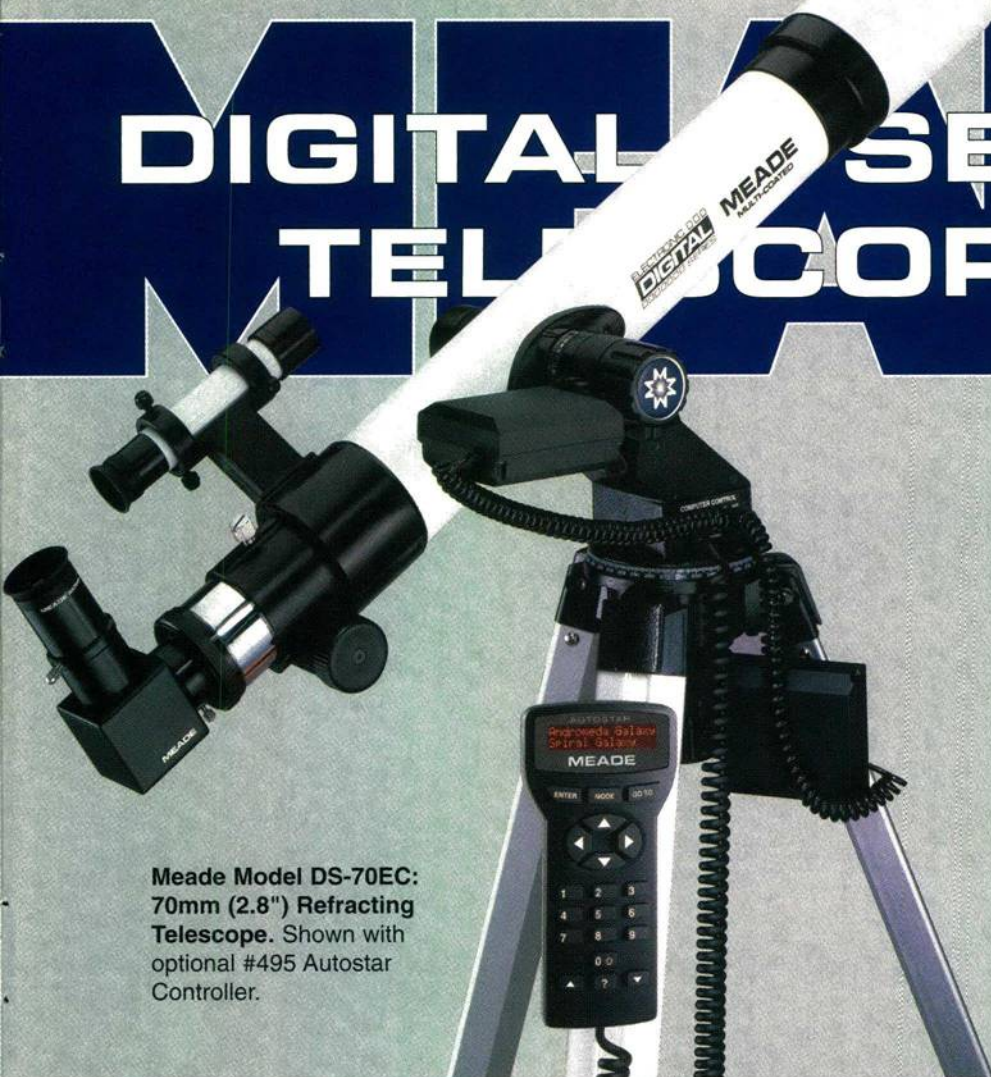
Meade Instruments Corporation

The largest-selling telescopes in the world. □ A NASDAQ company.

6001 Oak Canyon, Irvine, California 92618 □ (949) 451-1450
FAX: (949) 451-1460 □ www.meade.com

© 2000

DIGITAL SERIES TELESCOPES



Meade Model DS-70EC: 70mm (2.8") Refracting Telescope. Shown with optional #495 Autostar Controller.

Meade Digital Series (DS) Telescopes offer the widest range of features ever made available in telescopes of their price class. The standard-equipment Electronic Controller (EC) permits precise pushbutton slewing and tracking at any of four speeds. Available optionally, the #495 Autostar Controller allows for automatic GO TO operation.

Digital Electronic Series Telescopes by Meade®: High Technology, Low Prices.

Now even the beginning or casual observer can enjoy the benefits of the very latest in digital microprocessor technology. Meade Digital Series (DS) telescopes are a revelation of electronic capability, premium-grade optics, and mechanical precision.

Electronic Controller: Use the Electronic Controller, provided as standard equipment with all DS-EC models, at any of four dual-axis speeds

from 2 arcmins/second to 6°/second, to center and track astronomical objects at any magnifying power.

Altazimuth Mountings: Engineered for smooth dual-axis tracking, Digital Series altazimuth mounts provide a level of mechanical precision previously unavailable on beginning- and intermediate-aperture telescopes.

Optical Systems: Meade DS refracting telescope models include 2-element multi-coated achromatic objective lenses, precision polished from crown and flint optical glass components. Newtonian reflecting telescopes of the series include primary and secondary mirrors free of the

optical zones and irregularities often found on optics of lesser quality.

Optional #495 Autostar Controller: Plug in the Meade #495 Autostar Controller to the control panel of your DS-EC telescope, and you're ready to locate any of over 1500 celestial objects in the Autostar database, including hundreds of galaxies, nebulae, star clusters, the complete Messier and Caldwell deep-space catalogs, and more — all at the push of the GO TO button.



The standard-equipment Electronic Controller of Meade DS-EC models.

Specifications: Each Meade Digital Series telescope described here is *supplied complete* as shown in the photo below, with aluminum field tripod, two eyepieces (1.25"), diagonal mirror, 5 x 24mm or 6 x 30mm finder, Electronic Controller with dual-axis motors, and battery pack (accepts ten AA-size user-supplied batteries.) See the Meade General Catalog for complete specifications.

MEADE DIGITAL SERIES TELESCOPES

DS-60EC: 60mm (2.4") Refractor	\$299
DS-70EC: 70mm (2.8") Refractor	349
DS-80EC: 80mm (3.1") Refractor	449
DS-90EC: 90mm (3.5") Refractor	499
DS-114EC: 114mm (4.5") Reflector	399
DS-127EC: 127mm (5.0") Reflector	449
#495 Autostar for any above model	99

Prices shown are suggested U.S. mail-order retail prices. Patents pending on DS systems architecture and Autostar.



ADVANCED PRODUCTS DIVISION

Meade Instruments Corporation

The largest-selling telescopes in the world. ■ A NASDAQ® company.
6001 Oak Canyon, Irvine, California 92618 ■ (949) 451-1450
FAX: (949) 451-1460 ■ www.meade.com © 2000

Left-to-right: Meade DS-60EC, DS-70EC, DS-80EC, DS-90EC, DS-114EC, DS-127EC



RESEARCH-GRADE ACCESSORIES

Series 4000™ Super Plössl

52° field; multi-coated



Meade 4-element Super Plössl, updated and redesigned to utilize the latest in optical glass-types, are the finest general-purpose eyepieces available. For observing high-contrast lunar and planetary detail, splitting close doubles, or for deep-space; guaranteed to deliver more contrast and image sharpness than any other brand. Rubber eyeguards fold down for eyeglass wearers—a feature not available on competing brands. Multi-coated. All focal lengths through 32mm are parfocal.

Super Plössl (SP; 4-elements; 1.25"; 52°):
 6.4, 9.7, 12.4, 15, 20, 26mm each: \$79.95 (4.54)
 32mm (52°); 40mm (44°) each: 99.95 (5.26)
 56mm (52°; 2°) 199.95 (7.02)

Series 4000™ Ultra Wide Angle

84° field; multi-coated



The ultimate eyepieces; extreme image sharpness over an amazing 84° field. A perfect optical match with Schmidt-Cassegrains and fast Newtonians.

Ultra Wide Angle (UWA; 8-elements; 1.25"; 84°)—4.7mm: \$169.95 (5.26); 6.7mm: 199.95 (5.26); 8.8mm (1.25"/2"): 239.95 (7.02); 14mm (1.25"/2"): 299.95 (7.02)

Series 4000™ f/6.3 Focal Reducer/Field Flatteners

Manufactured to exclusive Meade optical designs; threads on to any Meade or Celestron Schmidt-Cassegrain rear cell and converts f/10 scopes to f/6.3 (or f/6.3 SCT's to f/4), while significantly flattening the field. Use with SCT visual or photo accessories. Actual visual field is increased by 56%, for fine wide-field views of star fields and nebulae. In astrophotography, reduces exposure times by about 50%, while producing an actual field diameter of 1.5" at the film plane. A tremendous aid with CCD imagers in reducing image size for locating and centering images on CCD chips. 4-element optics; multi-coated; 41mm clear aperture. **\$129.95 (5.26)**

2x Telenegative Barlow (1.25")

#122: Doubles eyepiece power with sharp, high-resolution, high-contrast imaging on telescopes of all types. 27mm dia. (26mm clear aperture). Excellent corrections for chromatic and spherical aberrations at all photo-visual wavelengths. Multi-coated. 1.25" **\$47.95 (4.54)**

2x Short-Focus Barlow (1.25")

#126: Only 2.5" long, the #126 works well with any telescope accepting 1.25" eyepieces, even those with limited focus range. Maintains the high image quality of the #122, above. Insert the #126 into star diagonal for 2x or insert star diagonal into #126 for 3x. 26mm clear aperture. Multi-coated. **\$47.95 (4.54)**

2x-3x Variable Barlow (1.25")

#127: Precision internal sliding lens assembly permits continuously variable power settings between 2x and 3x. Engraved scale indicates power in use. Yields bright, sharp, high-contrast images on telescopes of all types. Multi-coated; 1.25". **\$59.95 (4.54)**

2" Diagonal Mirror

#929: Permits use of wide-field 2" oculars. Threads on to rear cell of Meade and Celestron SCT's. Includes multi-coated precision optical flat made at the Meade factory; with 1.25" eyepiece adapter. **#930:** Same as #929 but with 2" barrel to fit into focuser with 2" eyepiece-holders. **#929 or #930, each: \$99.95 (6.85)**

45° Erecting Prisms

Fully coated roof prisms to invert the astronomical image in Schmidt-Cassegrains or reflectors during terrestrial observations, while presenting a convenient 45° observing angle. Specify **#927 (.965")**, **#928 (1.25")**, or **#931 (fits .965" focuser, accepts 1.25" eyepieces)**. **\$42.95 (3.86)**

World's Most Advanced Illuminated Reticle Eyepiece

Series 4000 Plössl 9mm, with rubber eyecup and micrometric X-Y positioning of the reticle within the field. Greatly facilitates locking on the guide star. Sharp high-power imaging, excellent eye relief. Wireless red LED illuminator with adjustable brightness control. Multi-coated optics. Internal batteries included. **Bullseye reticle, 1.25", \$149.95 (6.14)**

Series 4000 Plössl 9mm—Same as above but with 6 ft. cord and plug for Meade LX3, LX5, LX6, LX100, LX200, and APO power panels, in place of wireless illuminator. **\$129.95 (5.26)**



Series 4000 Photo-Visual Color Filters (1.25")—Premium filters, made of purest crown optical glass, dyed in the mass. For increased contrast and resolution on the Moon and planets. Thread into the barrels of virtually all 1.25" eyepieces sold today. Fully coated.

#8 LT. Yellow; #11 Yellow Green; #12 Yellow; #21 Orange; #23A LT. Red; #25A Red; #38A Dark Blue; #47 Violet; #56 LT. Green; #58 Green; #80A Blue; #82A LT. Blue each **\$14.95 (2.73)**
Set #1—4 filters: #12, #23A, #58, #80A 49.95 (4.54)
Set #2—4 filters: #11, #25A, #47, #82A 49.95 (4.54)
Set #3—4 filters: #8, #21, #38A, #56 49.95 (4.54)

Series 4000 Moon Filter (#ND96): Reduces glare and irradiation during lunar observing. 13% uniform light transmission across the visual spectrum. Threads into 1.25" barrels. **\$16.95 (2.73)**

#905 Variable Polarizer (1.25")

For glare reduction in observing the Moon. Includes two Polarizer filters mounted in a machined cell and permits continuously variable light transmission from 5% to 25%, to compensate for varying lunar surface brightness according to the Moon's phase and the aperture of the telescope. Accepts 1.25" eyepieces. **\$49.95 (5.26)**

Electric Focusers for SCT's

For extremely smooth microfocusing of the image. Does not affect use of the manual coarse-focus knob.

#1206 Electric Focuser: Plugs into control panel of Meade 8", 10", 12" LX200 models and operates from LX200 hand controller. **\$149.95 (7.48)**

#1205 Electric Focuser: For all other Meade 8", 10", 12" SCT models; includes separate hand controller; accepts one self-contained (user-supplied) 9v battery. **\$169.95 (7.86)**

#777 Off-Axis Guider for SCT's

Internal prism diverts light for monitoring telescopic image during long-exposure astrophotography. Threads to any Meade or Celestron rear cell. Use with illuminated reticle eyepiece and T-mount for your 35mm camera. **\$79.95 (6.85)**

Series 4000™ 2x Apochromatic Barlow Lens

#140: The most advanced Barlow lens available for commercial telescopes, the Meade #140 includes 3-element, multi-coated, air-spaced optics. Doubles the power of any eyepiece with which it is used and yields images absolutely unmatched in resolution, contrast and color correction. The #140 optically complements any telescope — refractor, reflector, or Schmidt-Cassegrain. Accepts 1.25" eyepieces. Mechanical components are of machined aluminum and brass. Lens diameter is 28mm; clear aperture 26mm. **\$79.95 (5.26)**

Series 4000™ Super Wide Angle

67° field; multi-coated



For exquisite wide-angle images at low-to-medium powers, with pinpoint edge-of-field resolution. Ideal for star fields, galaxies, and other deep-space phenomena. SWA 13.8mm, 18mm, and 24.5mm are superb complements to the #140 Barlow, above.

Super Wide Angle (SWA; 6-elements; 1.25"; 67°)—13.8mm: \$139.95 (4.54); 18mm: 149.95 (4.54); 24.5mm: 179.95 (5.26); 32mm (2"): 239.95 (7.02); 40mm (2"): 299.95 (7.02)

Series 3000™ Plössl

50° field; multi-coated



Meade Series 3000 Plössels yield the finest image corrections obtainable from the classical 4-element Plössl design. Focal lengths from 5mm through 25mm are parfocal, so that, at most, only slight refocusing of the image is necessary from eyepiece to eyepiece. Unlike competing moderately-priced Plössels, Meade Series 3000's are multi-coated for maximum light transmission and image contrast. Chrome-plated brass barrels are threaded for standard filters. All eyepieces are fitted with fold-down rubber eyecups for comfortable observing. The PL40mm (far right in photo), an excellent complement to any ocular set, produces spectacular low-power, wide fields, ideal for scanning the Milky Way. Manufactured exclusively to Meade optical designs, Series 3000 Plössels yield fine, high-resolution results on reflectors, refractors, and Schmidt-Cassegrains of any focal ratio.

Series 3000 Plössels (4-elements; 1.25"; 50°)
 5, 6.7, 9.5, 16, 25mm each: **\$49.95 (3.86); 40mm (44° field): \$79.95 (3.86)**



Series 4000 Nebular Filters—Premium multi-layer interference filters, the finest obtainable. Use broadband ("B") filters to block most forms of light pollution; use narrowband ("N") filters in heavily light-polluted areas or for extremely high-contrast observing of faint nebulae.

#908B—Threads into 1.25" eyepieces, 26mm dia. **79.95 (4.54)**
#910B—Threads into 2" eyepieces, 44mm dia. **119.95 (5.26)**
#911B—Threads on to rear cell of Schmidt-Cassegrain telescopes. 36mm dia. **99.95 (5.26)**
#908N—Threads into 1.25" eyepieces, 26mm dia. **89.95 (4.54)**
#910N—Threads into 2" eyepieces, 44mm dia. **129.95 (5.26)**
#911N—Threads on to rear cell of Schmidt-Cassegrain telescopes. 36mm dia. **119.95 (5.26)**

Series 4000 Oxygen-III Filters Observe diffuse emission and planetary nebulae as you never thought possible! Exclusive Meade 60-layer interference coating technology isolates the 496nm and 501nm O-III lines to tremendously enhance observable nebular structural detail in all telescopes.

#908X—Threads into 1.25" eyepieces, 26mm dia. **99.95 (4.54)**
#910X—Threads into 2" eyepieces, 44mm dia. **159.95 (5.26)**
#911X—Threads on to rear cell of Schmidt-Cassegrain telescopes. 36mm dia. **149.95 (5.26)**

Modified Achromatic Eyepieces

Meade 3-element MA eyepieces yield sharp, well-corrected images on the Moon, planets, and deep-space at a reasonable price. Multi-coated; threaded for filters: 1.25" barrel diameter. Apparent field: 40°. MA 9, 12, 25, 40mm. **each: \$37.95 (4.54)**

MA12mm Illuminated Reticle Eyepiece

Excellent 3-element optical system, long eye relief, fully coated, with double crossline reticle, rubber eyecup. Wireless red LED illuminator and variable brightness control. 1.25". Batteries included. **\$99.95 (3.45)**
 As above but with 6 ft. cord and plug for Meade telescopes with power panels, in place of wireless illuminator. **\$79.95 (5.26)**

Camera Adapters

Professional-quality adapters for rigid coupling of telescope-to-camera. Use for either Eyepiece-Projection or Prime Focus. Precision-machined of aluminum and brass, threaded for filters. Use with T-mount, available separately. **.965": \$27.95; 1.25": \$29.95 (3.86)**

Variable-Projection Camera Adapter (1.25")

Machined sliding cell allows variable projection power in eyepiece-projection photography; permits precise selection of correct photo power in lunar and planetary photography; threaded for filters. Use with T-mount for your camera. **\$39.95 (3.86)**

Variable Tele-Extender

For eyepiece-projection photography with any Meade or Celestron SCT. Threads on to eyepiece-holder. Sliding cell with lock permits wide range of projection magnifications with the same eyepiece. Use with T-mount for your camera. **\$39.95 (3.86)**

T-Adapters for SCT's

Rigidly couples camera to telescope for prime focus photography with any Meade or Celestron Schmidt-Cassegrain. Use with T-Mount for your 35mm camera. **\$26.95 (3.86)**

CCD-Photo-Visual Flip-Mirror Systems

An essential accessory for imaging with any brand of CCD imager or for astrophotography with a 35mm camera. Flip mirror "up" to pass light on to CCD chip or 35mm camera film plane. Each unit includes: precision optical-flat Pyrex® mirror, 2-axis mirror-adjustment screws and locks for precise image centering; extra-fine helioid focusing of the eyepiece; extension tubes for attaching either 35mm camera (using T-Mount) or CCD imager (using either T-threads or 1.25" barrel). Threads to rear cells of all Schmidt-Cassegrain telescopes; may remain on telescope and used in place of diagonal prism for visual observing as well.

"Over the past 10 years I have used all manner of flip-mirrors. The Meade Flip-Mirror Systems are absolutely the best—rock solid, high-precision, beautifully manufactured; they virtually eliminate all flexure between the CCD and telescope." — Jack Newton



NEW!

#644 Flip-Mirror System: Accepts any 1.25" eyepiece. Mirror clear aperture: 22mm. Use with CCD's up to Pictor 416XT or ST-7, or smaller; or visual observing with 1.25" eyepieces. **\$149.95** (7.02)

#647 Flip-Mirror System: Accepts either 1.25" or 2" eyepieces. Mirror clear aperture: 40mm. Recommended for full-field 35mm astrophotography or with CCD's of any size, including all Meade Pictor Series through 1616XT, as well as ST-4 through ST-8; or for visual applications with 1.25" or 2" eyepieces. **249.95** (8.49)

#157 1.25" Adapter: Permits use of either Flip-Mirror on telescopes with 1.25" eyepiece-holders. (Requires approx. 2" additional focus travel with #644, 3" with #647.) **15.00** (3.86)



Series 4000™ 1/3.3 CCD Focal Reducer/Field Flattener

Revolutionary 3-element Meade design permits ultrafast CCD imaging with increased edge-of-field resolution and color correction! Reduces CCD exposure times by up to 80%. Threads on to the rear cell of any Meade or Celestron Schmidt-Cassegrain. Converts f/10 Schmidt-Cassegrain telescopes to f/3.3 and f/6.3 SCT's to f/2. Variable T-Adapter (included) allows range of ratios between f/3 and f/5 on f/10 SCT's and between f/1.9 and f/3.2 on f/6.3 SCT's. Use with CCD imagers of any brand and chip dimensions. Not for visual or photographic applications. Multi-coated; 41mm clear aperture. **\$149.95** (5.26)

NEW!

Plössl 25mm Illuminated Reticle CCD Framing Ocular



NEW!

Displays rectangular frames of all popular CCD chip sizes, including all Meade Pictor models and ST-4 through ST-8. Shows precisely the image size and orientation that appear on CCD chip. Insert directly into telescope eyepiece-holder, or use with Flip-Mirror (above). Includes 4-element coated Plössl optics; lookable spacer ring to fix focus position; rubber eyecup; variable LED illumination control; batteries. 1.25". **\$129.95** (4.54)

#825 8 x 25mm Right-Angle Viewfinder for ETX-90



Permits comfortable right-angle viewing. Replaces standard eyepiece finder on 90mm ETX models, using the same bracket. Wide-angle, achromatic, coated optics; actual field 7.5". Precise helioid focusing. **\$49.95** (4.26)

NEW!

#64 T-Adapter for ETX®

Threads to the photo port of all ETX-90 and ETX-125 models. Rigidly couples any 35mm camera with removable lens to the telescope for lunar, planetary, or terrestrial photography. Includes extension tube for longer effective focal length, if desired. Use with T-Mount for your 35mm camera. **\$34.95** (3.86)



MA12mm Illuminated Reticle Astrometric Eyepiece



A high-precision eyepiece for a wide range of astronomical measurements. Includes four red-illuminated, laser-etched scales for measuring double star angular separations, position angles, planetary diameters, and lunar crater diameters, and for long-exposure photo-guiding. Modified Achromatic 3-element coated optics; diopter adjustment; rubber eyecup; variable LED illumination control; batteries. 1.25". **\$119.95** (4.26)

NEW!

Series 4000™ 8mm - 24mm Zoom Eyepiece

The finest zoom eyepiece available, by Meade specifically for ETX-90 and ETX-125 Astro Telescopes. Tripod height adjusts from 34" to 54", for seated or standing observations. Micrometric controls in azimuth and elevation permit precise polar alignment of the ETX fork mount. Tripod head tilts and locks to 90° for terrestrial applications. Telescope attaches to tripod in seconds with 2 thumb screws. All-aluminum construction. **\$219.95** (6.38)



NEW!

ETX® Deluxe Field Tripod

#883: Custom-designed by Meade specifically for ETX-90 and ETX-125 Astro Telescopes. Tripod height adjusts from 34" to 54", for seated or standing observations. Micrometric controls in azimuth and elevation permit precise polar alignment of the ETX fork mount. Tripod head tilts and locks to 90° for terrestrial applications. Telescope attaches to tripod in seconds with 2 thumb screws. All-aluminum construction. **\$199.95** (10.00)



ETX® Hard Carrying Cases

For secure storage or travel with your ETX. Thick-wall construction and die-cut foam lining. Accepts telescope, plus optional eyepieces, erecting prism, table tripod, hand controller, etc. Includes two steel latches with key. **#774 Case for ETX-90 models: \$99.95** (8.58) **#775 for ETX-125EC: \$149.95** (13.38)



ETX® Carry Bag

Soft-padded Cordura-type carry bag with shoulder strap; permits storage of any 90mm ETX model, plus table tripod legs, eyepieces, other accessories. **\$36.95** (5.26)



Electric Focusers for ETX®

Meade-engineered for smooth, rapid focusing with any ETX model. Four-speed operation from coarse to fine. Standard equipment hand controller accepts one 9v. (user-supplied) battery and focuses all ETX telescopes. Or focus ETX/EC models through the telescope's hand controller. **#1244 Electric Focuser for all ETX-90 models: \$119.95** (6.85) **#1247 Electric Focuser for ETX-125 models: \$119.95** (6.85)



#932 45° Erecting Prism for ETX®

For terrestrial observing with any ETX-90 or ETX-125 model. Yields correctly oriented image and convenient 45° observing angle. Threads to ETX rear cell. Accepts any 1.25" eyepieces. Coated roof prism optics. **\$49.95** (3.86)



HOW TO ORDER

Prices shown are suggested U.S.A. mail-order retail prices and do not include any applicable sales taxes. Suggested shipping and handling charges to the 48 states by U.P.S. or U.S. Mail shown in () next to each price. The following national mail-order dealers carry all Meade accessories in-stock for immediate shipment:

- ASTRONOMICS, Norman, OK.
Orders: 800-422-7876; Info.: 405-364-0858.
- FOCUS CAMERA, Brooklyn, NY.
Orders: 800-221-0828; Info.: 718-436-6262.
- LUMICON, Livermore, CA.
Orders: 800-767-9576; Info.: 925-447-9570.
- OCEANSIDE PHOTO & TELESCOPE, Oceanside, CA.
Orders & Information: 800-483-6287.
- POCONO MOUNTAIN OPTICS, Moscow, PA.
Orders: 800-569-4323; Info.: 570-842-1500.
- RIVERS CAMERA, Dover, NH.
Orders: 800-245-7963; Info.: 603-742-4888.
- SHUTAN CAMERA & VIDEO, Chicago, IL.
Orders & Info.: 800-621-2248; IL: 312-332-2020.

- Canada:
EFSTONSCIENCE, Toronto, Ontario.
Orders & Information: 416-787-4581.
- KHAN SCOPE CENTRE, Toronto, Ontario.
Orders & Information: 416-783-4140.

THE LARGEST-SELLING TELESCOPES IN THE WORLD

MEADE

See these authorized Meade dealers for information on any of forty Meade telescope models, from entry-level telescopes under -\$200 to professional instruments over \$15,000.

NATIONAL

*Meade Telescopes and Accessories
are available at*

DISCOVERY CHANNEL STORE

Call for location nearest you.

Call 1-800-222-6105

CALIFORNIA

Huge Meade inventory at low prices

Woodland Hills Camera Telescopes • Binoculars

5348 Topanga Canyon Blvd., Woodland Hills, CA 91364

818-347-2270 or toll-free

Buy, Sell 1-888-4-ASTRONOMY Trade

FLORIDA

PHIL'S CAMERA SERVICE

*South Florida's Largest Selection of
Quality Optical Instruments.*

11635 S. Dixie Hwy., Miami, FL 33156

www.philscamera.com

305-238-7842

ARIZONA

ASTRONOMY SHOPPE

*Authorized Meade Dealer
Serving the Greater Phoenix Area*

3202 E. Greenway Rd., Suite 1615,
Phoenix, AZ 85032

1-888-999-6396

CALIFORNIA

Largest Meade Display in California!

Boot's Camera

5587 North Blackstone Ave.,
Fresno, CA 93710

559-432-0446

FLORIDA

Complete line of fine Meade Products

Kenin Scientific & Optical Products

Big Display and We Do Mail Orders

1830 N.E. 163 St. • North Miami Beach

Phone: 305-940-7804 • Fax: 305-947-5943

ARIZONA

Quality Meade telescopes and accessories

Mr. Telescope

20 E. Camelback Rd., Phoenix, AZ 85012

602-955-5521

COLORADO

Mike's Camera, Inc.

*We carry one of the largest supplies of
quality telescopes and accessories.*

Boulder Littleton Denver

303-443-1715 303-708-9655 303-733-2121

IOWA

THINKER TOYS, INC.

Quality Meade telescopes and accessories

4400 Singing Hills Boulevard

Sioux City, IA 51106

712-271-8697

CALIFORNIA

Studio City Camera

Full-line Meade. Optical expert on staff. Over
50 years' experience selling telescopes!

12174 Ventura Blvd., Studio City, CA 91604

818-762-4749

CONNECTICUT

WHOLESALE OPTICS

WWW.ASTROPTX.COM

E-MAIL: astroptx@astroptx.com

Phone Orders 7 Days 9 am - 12 midnight • Sat. Hrs.: 11 am - 5 pm

Showrooms/Business Office:

57 North St., Suite 401, Danbury, CT 06810

Phone: 860-355-3132

GEORGIA

Camera Bug Ltd.

*Atlanta's Leading Telescope and Binocular Dealer.
We Ship Practically Anywhere.*

1799 Briarcliff Rd., Atlanta, GA 30306

404-873-4513 • Fax 873-3925

CALIFORNIA

WHAT IN THE WORLD

*We will demo Meade products in our dark
mountain skies!*

28200 Hwy. 189, #E-210

Lake Arrowhead Village, CA 92352

909-337-5080

DELAWARE

CUTLER CAMERA

Binocular and Telescope Specialists

Stores in Wilmington, Newark and Dover

403 Branmar Plaza, Wilmington, DE 19810

888-442-8821

MASSACHUSETTS

F.C. Meichsner Co.

*Decades of sales and service to New England's
astronomers. Visit our accessible Boston showroom.*

182 Lincoln St., Boston, MA 02111

1-800-321-VIEW

CALIFORNIA

Claremont Camera & Video

*If it's quality Meade telescopes you're
looking for - We offer it all!*

863 W. Foothill Blvd., Claremont, CA 91711

909-626-2219

FLORIDA

National Camera & Digital Imaging

*Competitive Prices! Expert Service! Sales
Nationwide! 35 Year Reputation.*

1650 North Military Trail, Suite 104

West Palm Beach, FL 33409, 561-689-3155

Out of State 1-800-9-CAMERA

MASSACHUSETTS

*Full-line dealer! We accept trade-ins! Meade
telescopes on display for your inspection!*

Harvard Camera

Town of Harvard: 978-456-8100

Fitchburg: 978-345-2144

MICHIGAN

RIDER'S HOBBY SHOPS

Serving Michigan Since 1972
Competitive Discount Prices
 For the store location nearest you call
888-530-9780. Locations throughout
 Michigan. [HTTP://RIDERS.COM](http://RIDERS.COM)

MINNESOTA

RADIO CITY INC.

Full stocking Meade dealer serving the upper
 midwest. "We can help." radioinc.com
 2663 County Rd. I, Mounds View, MN 55112
1-800-426-2891 • 763-786-4475

MONTANA

NIGHT SKIES

Come and see the largest display of
 telescopes and accessories in Montana.
 1550 Amsterdam Rd., Belgrade, MT 59714
 Phone: 406-388-1205 e-mail: nightsky@wtp.net

NEBRASKA

ROCKBROOK CAMERA & VIDEO

Nebraska's Authorized Meade Dealer
 2 Locations:
 108th & W. Center Rd. 40th & O St.
 Omaha, NE 68144 Lincoln, NE 68510
402-397-1171 402-488-4200

NEW JERSEY

N.J.'s Largest Display of Meade Telescopes.

Dover Photo Supply

25 E. Blackwell St.
 Dover, NJ 07801
973-366-0994

NEW JERSEY

EDMUND SCIENTIFIC COMPANY

Call for a free catalog or see our full Meade
 line in our showroom.

101 East Gloucester Pike, Barrington, NJ 08007
1-800-728-6999

NEW MEXICO

PhotoSupply, Inc.

Stocking New Mexico's largest selection of
 Meade telescopes.
 DeVargas Shopping Ctr., Santa Fe, NM 87501
505-982-2585

NEW YORK

Berger Bros. Camera & Video Exchange

Excellent Advice, Prices and Reputation
 For 50 Years

209 Broadway (Rte. 110), Amityville, LI, NY 11701
1-800-262-4160 • 631-264-4160

NEW YORK

B & H PHOTO VIDEO

We carry a full line of quality Meade telescopes
 420 9th Avenue, New York, NY 10001
www.bhphotovideo.com
1-800-947-9970 • (212) 444-6670

NEW YORK

We have specialized in sales and repair of telescopes
 for over 20 years! See us for expert advice!

Johnson Camera

6565 Kinne Rd. at Erie, Syracuse, NY 13214
315-446-0290

NORTH CAROLINA

Your quality Meade dealer in North Carolina

CC Sales/ Camera Corner

Phone: 800-868-2462
 Fax: 336-222-8011
 e-mail: sky@camcor.com
 2273 S. Church St., Burlington, NC 27215

OHIO

Pete's PhotoWorld

Competitive Prices! Great Service!
 Telescope expert on staff Ask for Craig
 Telescope FAQ's www.photoworld.com
 7731 Beechmont Ave, Cincinnati, OH 45255
petes@photoworld.com 1-800-736-7383

OHIO

McALISTER CAMERA & VIDEO

Full Line Meade. Reputable Dealer With
 Competitive Prices. Call Eric For Advice.
 588 W. Schrock Road
 Westerville, OH 43081 (Columbus)
 Phone: 614-794-1865

PENNSYLVANIA

The Camera Shop In Bryn Mawr

Suburban Philadelphia's
 Photo & Optical Specialists
 572 Lancaster Ave., Bryn Mawr, PA 19010
610-527-0300

PENNSYLVANIA

CUTLER CAMERA

Binocular and Telescope Experts
 7 Locations in PA and NJ
 Largest Dealer in the Delaware Valley
 314 Horsham Rd., Horsham, PA 19044
215-674-5727 • 1-800-220-5727

SOUTH CAROLINA

Wonder Works

Friendly, helpful service!
 Open 7 days a week.
 280 W. Coleman Blvd., Mt. Pleasant, SC 29464
 Toll-Free 888-849-5540
www.wonderworkscharleston.com

TEXAS

Analytical Scientific

If it's a quality Meade telescope you're looking for, call us.
 11049 Bandera Rd., San Antonio, TX 78250
210-684-7373 • 800-701-STAR
<http://www.analyticalsci.com>

TEXAS

Land, Sea & Sky Unlimited

Complete sales and service of Meade
 telescopes. We are optical specialists.
 3110 S. Shepherd Dr., Houston, TX 77098
713-529-3551
www.neosoft.com/~lsstnr

WASHINGTON

Captain's Binoculars & Telescopes

Optical specialists, not just order-takers. • 2 locations:
 2500 15th Ave. West, Seattle, WA 98119
206-283-7242
 3333 184th St., S.W., Suite W, Lynnwood, WA 98037
425-670-8797
www.captainsnautical.com

WASHINGTON

Meade Telescopes & Accessories

The Naturium

Kitsap Mall, Silverdale, WA
360-698-3580

WASHINGTON

Anacortes Telescope & Wild Bird, Inc.

3202 Commercial Ave., Anacortes, WA 98221
360-588-9000 • Fax 360-588-9100
<http://www.buytelescopes.com>

WISCONSIN

EAGLE OPTICS

Authorized Meade Dealer. We've built a
 nationwide reputation for quality sales and service.
 2120 W. Greenview Dr., Middleton, WI 53562
1-800-289-1132
www.eagleoptics.com

CANADA

PERCEPTOR

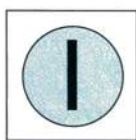
Friendly Service, Expert Advice, Low Prices,
 Full Meade Line, Delivery Across Canada
 Brownsville Jct. Plaza, Box 38, Suite 201
 Schomberg, Ontario L0G 1T0
905-939-2313 • Fax 905-939-8274

CANADA

LA MAISON DE L'ASTRONOMIE

Competitive Prices • Expert Service
 7974 St. Hubert, Montreal, Quebec H2R 2P3
514-279-0063 • Fax 514-279-9628
 e-mail: rlotte@interlink.net
<http://www.microid.com/maison.htm>

Women Work



just finished reading Ann Finkbeiner's article "Good Morning, Gentlemen and Meg" (November 2000), on

the difficulties female astronomers encounter in the pursuit of their field. It mentioned about a dozen prominent women in astronomy but failed to highlight their field of interest or discoveries.

Maybe female astronomers' recognition suffers because popular magazines such as yours are more interested in writing about the struggle of these women than their interests. I recall reading other biographies on female astronomers that also failed to discuss the science. Instead, the authors focused on family balance issues and career progression.

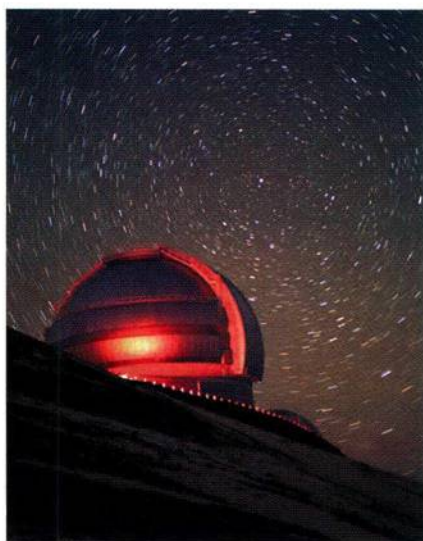
Please strive to be a pure science magazine. Write about the research, the discoveries, and the theories (regardless of gender). In the end, I buy your magazine to learn about the science of astronomy. — *Rich Graylin, Boulder, Colorado*

Previous articles detailing the work of many of the women mentioned in Finkbeiner's piece have appeared in Astronomy during the past decade. Each woman in the story was identified and in several cases, her work described.

Astronomy takes the position that science cannot be separated from the rest of human life and behavior. The American Astronomical Society shares this view, because it has sponsored several seminars and meetings on the topic of women's successes in astronomy. There would be no science without human intelligence. Human behavior is an important part of science. — *Bonnie Gordon, Astronomy Editor*

Mapmaker

Bravo to Margaret Geller ("Star Mapper," November 2000), who has taken on the challenge of mapping the universe. She has a big job ahead map-



Internet data help the Gemini North Observatory avoid laser traffic jams. Gemini Observatory

ping millions of galaxies. What job security. It will last a lifetime. — *Sharon Diane Roberts, Edgewater, Florida*

High Sodium

The information about the Gemini telescopes in your October issue ("High-Tech Twin Towers") was very interesting. When lasers are used to produce artificial guide stars for the adaptive optics, won't the flash of light emitted by the sodium atoms be a big problem for the other very sensitive telescopes in use nearby? — *Al Crooke, Gainesville, Florida*

The photon flux from the laser guide star itself will approximate that of a magnitude 10 or 11 star, and the scattered laser light from the lower atmosphere will be significant as well. A plan to resolve the resulting "laser traffic control" issues for the telescopes at the summit of Mauna Kea involves collecting pointing information for each telescope using real-time data via the Internet. Any conflict will be resolved in favor of the telescope without a laser. — *Brent Ellerbroek, Gemini AO Program Manager, Mauna Kea, Hawaii*

Blatant Blunders

In October's *Strange Universe*, Bob Berman said the northern lights are not particularly colorful. I don't agree.

I worked for the fire department in Fairbanks, Alaska, during the winter of 1962–3. I was on ramp patrol when I noticed an aurora overhead. I stepped out into the extremely cold night air for a better look.

It was the most beautiful sight I've ever seen: A band of color stretched from horizon to horizon through the zenith. That aurora displayed all the colors of the rainbow — and they were much brighter than any rainbow I've ever seen. I've never been able to describe it adequately.

That winter there was an aurora every clear night, and it was always in color. But it was light green or pink, unlike that one special night that I will never forget. I've since wondered if any other amateurs ever saw such an incredible sight. — *Robert Gagnon, Racine, Wisconsin*

Skilled Labor

In "Astronomy Careers Beckon," by Marcia Bartusiak (November 2000), it was disheartening to read about Janice Lee's experience concerning the "noted theorist" who described observers as "the unskilled workers of the night shift."

Although the article was a wake-up call to the reality of professional science today, amateur astronomers have made and will continue to make significant contributions. An "unskilled worker of the night shift" labors to bring some sense of reality to oneself and the excitement of astronomy to anyone else willing to listen.

My primary mirror collects light that allows me to become aware of the past, the present, and maybe grab a little peek toward the future. My primary mirror allows me to realize my own insignificance. It's not the one that hangs over my vanity. — *David J. Kaplan, Gillette, New Jersey*

KALMBACH PUBLISHING CO.

PRESIDENT

Gerald B. Boettcher

VICE PRESIDENT, EDITORIAL, PUBLISHER

James J. Sloum

VICE PRESIDENT, MARKETING

Michael R. Stephens

VICE PRESIDENT, ADVERTISING

Scott Stollberg

CORPORATE ART DIRECTOR

Maureen M. Schimmel

MANAGING ART DIRECTOR

Lisa A. Zehner

PRODUCTION MANAGER

Annette Wall

CIRCULATION MANAGER

Michelle Spehr

CIRCULATION SPECIALIST

Kirsten King

ADVERTISING DEPARTMENT

(888) 558-1544

ADVERTISING SERVICES MANAGER

Sara Malin Everts

ADVERTISING SALES MANAGER

Howard Hoerl hhoerl@astronomy.com

ADVERTISING SALES REPRESENTATIVE

Michael Ellis mellis@astronomy.com

AD SERVICES REPRESENTATIVE

Joel Wingelman jwingelman@kalmbach.com

RETAIL TRADE ORDERS AND INQUIRIES:

(800) 558-1544, ext. 818; outside the U.S. and Canada: (262) 796-8776, ext. 818

SPECIAL E-MAIL ADDRESSES

Ask Astro askastro@astronomy.com

Hot Shots hotshots@astronomy.com

Star Stuff starstuff@astronomy.com

Talking Back talking@astronomy.com

Kids kids@astronomy.com

Customer Service customerservice@kalmbach.com

Ad Sales adsales@astronomy.com

Good Seeing

I'd like to add to Martijn Weterings' comment, "You don't need a big telescope" (October 2000). I'm legally blind and must relinquish seeing the heavens firsthand to magazine glossies. From only two or three inches, I can enjoy *Astronomy's* articles and images of places many orders of magnitude distant. Don't ever stop the talk or the flow of images peering into our universe. I don't want to go totally blind just yet. — Don Harper, Vandenberg Air Force Base, California

No Trousers Required

I believe the reason Earth is always pictured with the North Pole up ("Looking Up South," September 2000) is that it reflects the prevalent European mindset of scientists. Communities in the Southern Hemisphere certainly looked at the night sky with intelligence and imagination before what Australians sometimes refer to as the "coming of trousers."

Australian Aboriginal nations enjoy a background of at least 40,000 years of celestial observation and storytelling. There is no living historical equivalent for European astronomy. For Aboriginals, groups of stars can represent characters that demonstrate moral and social traditions.

These stories span millennia because the people are a part of the natural world: Unlike Europeans, Aboriginals aren't hampered by the expulsion from Eden myth. Astronomy and celestial mechanics govern travel, tides, crops, and social rituals on a fundamental level. The value of pre-European life is a live issue here in Australia. Astronomy doesn't need trousers. — Alan Plummer, Sydney, Australia

Name Correction

The name of Harvard University graduate student Saurabh Jha, mentioned in "Astronomy Careers Beckon" (November 2000), was misspelled. *Astronomy* apologizes for this error. **A**

Astronomy invites you to talk back. Send letters to Astronomy Talking Back, P.O. Box 1612, Waukesha, WI 53187; e-mail to talking@astronomy.com. Letters may be edited for space and clarity. Please include your city, state, and country with all correspondence. If you want to talk back to us, please visit our website, <http://www.astronomy.com>.

ECLIPSE SHADES™

Safe Solar Viewers

Custom
Imprinting
Available!



Eclipse Shades™ provide the ultimate in protection from harmful Solar Radiation. Lenses made of Optical Grade, Neutral Density 5 Mylar, filter out 100% of Ultra-Violet, 100% of Infra-Red, and 99.999% of Visible Light.

Quality Paper Eyewear & Specialty Optics



Rainbow Symphony, Inc.

6860 Canby Ave. #120, Reseda, CA 91335

1-800-821-5122 FAX (818) 708-8470

E-Mail: eclipse@rainbowsymphony.com

www.rainbowsymphony.com/soleclipse.html



• Instant height adjustment from 4" to 32".

• Works with any telescope: Refractor, Newtonian and Matsukov.



• Padded seat and back.

• Removable school type table (Optional). Perfect for writing, holding charts, and clip flashlight (not included). Rotates in and out.



• Reclinable for relax, naked eye or binocular watching. A must for a meteor shower.

Folds flat for storage and transport.

Observing Chair:

\$ 159.50 + S&H

Optional Table:

\$ 38.50 + S&H

NEW
Introductory offer:
Order before 15th Dec. 2000
Receive Table \$ 38.50
FREE



For further information or to order:
www.atinatech.com 1-800-843-9484
Dealer inquiries are welcome.

Computerized Telescopes!



ETX 70/AT
\$349⁹⁵

ETX 60/AT
\$299⁹⁵

Special section on our web site for AT accy's!

Meade Computer-controlled telescopes automatically find 1000's of objects with the push of a single button!



ETX 90/EC
\$599⁹⁵ ON SALE CALL!



ETX 125/EC
\$899⁹⁵ ON SALE CALL!



8" LX90
\$1699⁰⁰



7"-12" LX200's
\$Call

Accessories for your Meade Computer-Controlled Telescope!

	60/AT	70/AT	90/EC	125/EC	LX90	LX200	DS	
Autostar GOTO #497			x	x			x	\$150
Ac adapter #541	x	x	x	x	x	x	x	42
Barlow 2x APO Shorty	x	x	x	x	x	x	x	80
Case- hard #773	x	x						60
Case- hard attache			x					100
Case- hard #775				x				150
Case- soft Deluxe			x					80
Case- soft #765			x					42
Case- soft 8"					x			call
Case- soft 10"						x		180
Car cord 12 volt #607			x	x	x		x	30
Car cord 12 volt #1812						x		90
Camera adapter #60			x	x				37
Camera adapter #60ST	x	x						27
Camera adapter #62					x	x		32
Electric focuser #1206						x		154
Electric focuser #1244			x					Sale!
Electric focuser #1247				x				124
Finderscope R/A #825			x					52
Interface cord #505	x	x	x	x	x		x	30
Moon filter 1.25"	x	x	x	x	x	x	x	18
Power Package	x	x	x	x	x	x	x	100
Prism 45° erect #932			x	x				50
Prism 45° erect #933	x	x						50
Rigel Quickfinder	x	x	x	x	x	x	x	40
Skychart CD Rom	x	x	x	x	x	x		55
Solar Filter- glass (90mm)			x					82
Solar Filter- glass (125mm)				x				104
Solar Filter- glass (8")					x			139
Solar Filter- glass (10")						x		159
SCT thread adapter	x	x	x	x				32
Tele extender- mini	x	x	x	x				32
Tripod- tabletop #880	x	x	x					32
Tripod- tabletop #881				x				62
Tripod- deluxe field #882	x	x						100
Tripod- deluxe field #883	x	x	x	x				200
Tripod- deluxe field #887			x	x				350
Visual back 1.25"	x	x	x	x				32

Partial listing only... please call toll-free with any questions or for product availability!

New NexStars!



Newest in the Nexstar family. All come with motors and electronics pre-assembled.

- 60mm Refractor
- 80mm Refractor
- 4.5" Newtonian
- 102mm Maksutov

www.shutan.com for details!

Celestron NexStar-5

\$1199⁰⁰ CALL FOR PROMO PRICING!

NexStar-8

\$1699⁰⁰ Dozens of N5/N8 accy's in stock!



Powered by just 8-AA batteries, the n NexStar can slew to any one of 18,000 objects in its onboard database! Features Celestron's proven 5" or 8" SCT optics. Sturdy and solid. All load bearing components like the fork arm and drive base are made of metal for rigid low vibration performance. Two servo motors provide long operational life and quiet and accurate pointing. Celestron technicians also add Starbright multiccoatings that ensure optimum light transmission and bright, high-contrast images— images so high in quality, NASA even had a C5 optical tube onboard one of the space shuttles!



Order these and hundreds of other items online at www.shutan.com

Order Toll-Free or Online! Call us or visit our web site for Y2000 Discount Catalog! Order by NOON for same-day shipment. C.O.D. available, please inquire. We ship most accessory orders up to 5 lbs. for just \$7 via UPS Ground. Non-Meade products are available for Worldwide shipment-- information at www.shutan.com. Shutan is family owned and operated since 1918! Prices, specifications, and trade-in offers subject to change and do not include shipping/handling. © 10/2000 SC&V.

SHUTAN

camera & video

We welcome bids & PO's from Schools!

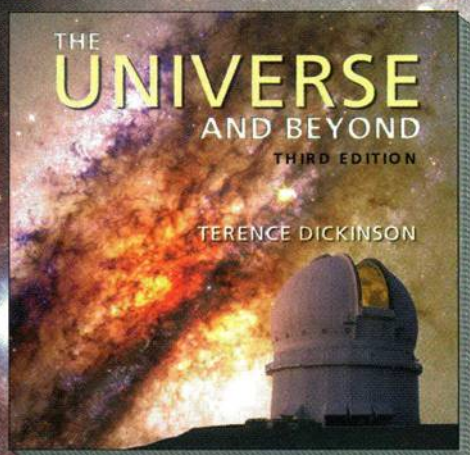
Toll-Free 800-621-2248

Illinois 847-367-4600 • www.shutan.com

100 Fairway Dr. • Vernon Hills IL • 60061

We Moved!

Books for every amateur astronomer's library by award-winning astronomy author Terence Dickinson



Oversize paperback, 168 pages \$29.95
isbn 1-55209-361-1

What's out there?

THE UNIVERSE AND BEYOND

3rd edition, enlarged and updated

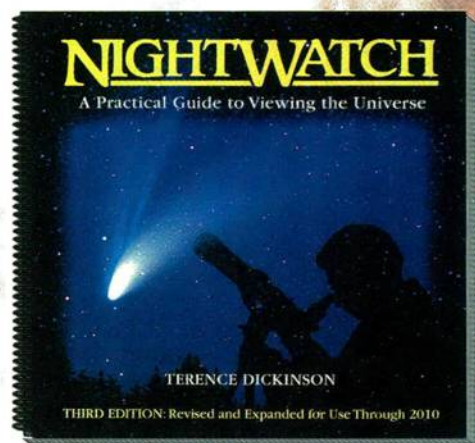
A fact-filled voyage through the universe, this completely revised edition includes coverage of recent developments in cosmology, planetary exploration, discoveries of other solar systems, the new 8-meter-class observatories and much more. Dickinson's lively writing style brings a "you-are-there" feel to this journey to the edge of space and time. Illustrated with more than 200 superbly reproduced photos and realistic artwork.

And how do you find and see it?

NIGHTWATCH

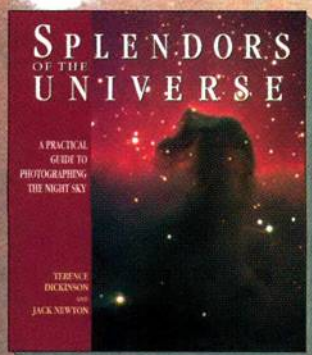
A Practical Guide to Viewing the Universe
3rd updated and expanded edition

Praised as an essential and classic handbook for backyard astronomers, **NIGHTWATCH** provides a wealth of practical information on choosing equipment and observing the night sky. Three levels of star charts offer an "ultrasimplified" path to knowing the sky for both beginners and more advanced amateur astronomers.

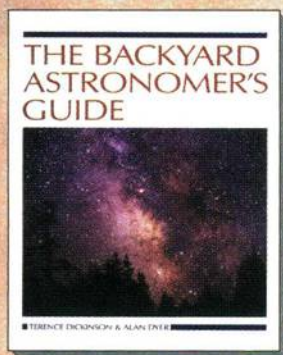


Oversize paperback, 176 pages
Coilbound to lie flat \$29.95
isbn 1-55209-302-6

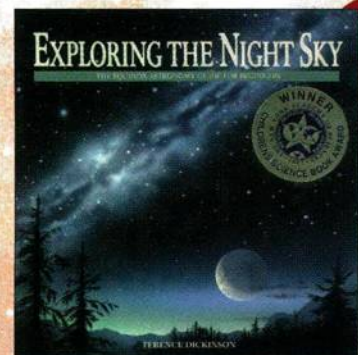
Also by Terence Dickinson



A Practical Guide to
Photographing the Night Sky
144 color pages \$40.00 hardcover
isbn 1-55209-141-4



300 pages \$39.95 hardcover
isbn 0-921820-11-9



64 pages \$9.95 paperback
isbn 0-920656-66-8

for
kids



Published by

FIREFLY BOOKS LTD.

At all bookstores
and astronomy shops.

3680 Victoria Park Avenue, Willowdale, ON M2H 3K1 • Tel.: 800-387-5085 • Fax 800-565-6034

Take A Journey To The Next Dimension. {You're Almost There.}



If you think peering into these depths is intriguing, try your eye at the wonders of space and time as seen through the power of a NexStar® telescope from Celestron®. ● These earthly wonders are the easiest and most advanced tools to locate, track, and study those naturally dimensional marvels of space. Indeed, NexStar telescopes are light years ahead of other computerized "Go-To"

telescopes, due in part to an amazing Auto-Align feature containing thousands of pre-programmed celestial sights that will have you up and observing in no time. There's even a communication port so you can control the NexStar from your personal computer. ● Take the NexStar 60 series for example. These 60mm refractors come with either a

directional hand control or fully computerized hand control with a database of up to 4,000 celestial objects. It includes three 1 1/4" eyepieces for magnifications

of 35x, 70x, and 175x, as well as *The Sky Level 1* CD-ROM software, plus a pre-assembled, adjustable aluminum tripod. ●

The NexStar 80 series, featuring an 80mm aperture, is a wide field

explorer with a 3.25° field of view capable of capturing the largest deep sky objects. This short tube, 400mm focal length refractor telescope takes you into space with a 16x and 40x magnification eyepiece. The pre-assembled tripod and quick-release coupling knob make this the most portable of the NexStar line. ●

The Nexstar 114 reflector telescope boasts 265 times the light-gathering power of the average human



NEXSTAR 80



NEXSTAR 60



NEXSTAR 114



NEXSTAR 5

eye, revealing fine detail within galaxies and nebulae. This compact model brings objects into view with a 114mm aperture and 1,000mm focal length capable of achieving magnifications of 40x and 100x with the standard eyepiece. ● Step up to the NexStar 5 for Schmidt-Cassegrain 5" optics with Starbright™ multi-coating, a premium 1 1/4", 25mm Plössl eyepiece, a f/10 focal ratio and 1,250mm

focal length. It can even be used as a spotting scope or 1250mm telephoto lens, and is perfectly suited for astrophotography. And its computerized features include Auto-Align, a tour function, a database of over 18,000 celestial objects, an easy-to-use hand control and a serial port for PC connection.

● Finally, the NexStar 8 comes with all the standard features of the NexStar 5, but adds Celestron's famous 8" optics with Starbright multi-coating, making it possible to offer images twice as bright as a 5" telescope.

● To learn more about Celestron's NexStar telescopes, visit us on the web at www.celestron.com. Or call (310) 328-9560 to find the NexStar dealer in your corner of the galaxy.



NEXSTAR 8

QUICK & EASY ASSEMBLY



FULLY ASSEMBLED TRIPOD



MOUNT SLIPS EASILY INTO TRIPOD HEAD



READY TO GO!

ACCESSORIES INCLUDED



COMPUTERIZED MULTI-SPEED HAND CONTROLLER



STARPOINTER ADVANCED RED DOT LED FINDERSCOPE



THE SKY LEVEL 1 CD-ROM



SPACE PROGRAM

NASA Shelves Pluto Mission

► Shocked. Incredulous. Heartbroken. Those are just some of the reactions expressed by planetary scientists to NASA's decision in September to cancel the scheduled 2004 launch of a long-planned mission to explore Pluto and the cometlike objects in the adjacent Kuiper Belt. The estimated cost of the mission had grown from \$350 million to about \$550 million, prompting the space agency to stop work on it, says NASA spokesman Donald Savage.

"Many other missions had similar cost growths, but the Pluto mission had a lower scientific priority," says Savage. "NASA has not canceled the Pluto mission; it has just delayed it." He notes that the failures of two Mars missions in 1999 prompted the space agency to spend more money on fewer missions to ensure the success of those that are funded. Several review commissions recommended the change.

"The issue is not so much the disappointment of the researchers themselves, but the loss of

Hubble gave us our best view yet of Pluto (left) and Charon.



R. Albrecht, ESA, and NASA



NASA/JPL

science for the nation," says Jonathan Lunine, a planetary scientist at the University of Arizona and past chairman of the Pluto Express Science Definition Team, a 1995–96 group that strongly recommended the mission. "This unexplored planet and nearby region of solar system have grown in importance since 1995 as remnant planetesimals in the Kuiper Belt

have been discovered. From the point of view of understanding planetary origins, it's sad that we are not going to send a spacecraft there for a while."

Unfortunately, Pluto is moving away from Earth on its 248-year elliptical orbit around the sun. The now-canceled 2004 launch of the Pluto-Kuiper Express (PKE) was timed so that the 763-pound (346 kg) spacecraft would be accelerated toward its final destination by flying close to Jupiter. The gravity-assist maneuver would have allowed PKE to arrive at Pluto by about 2020. The next launch date that could take advantage of a Jupiter gravity assist would be in 2014.

NASA's plans to explore Pluto have been postponed indefinitely.

America's longing to explore Pluto is reflected in the U. S. Postal Service's "Pluto — Not Yet Explored" stamp, issued in 1991. Louis Friedman, executive director of the Planetary Society, a 100,000-member organization that champions solar system exploration, says there is "extremely strong public support" for a Pluto mission. A Pennsylvania high school student has even established a website (www.plutomission.com) to rally support. Planetary scientists, most of whom will reach retirement age before any spacecraft reaches Pluto, feel helpless.

Dealer Page

**2835 Columbia St.
Torrance, CA
90503**

**(310) 328-9560
(310) 212-5835 Fax**

**Visit our website at
www.celestron.com**

National	CA	Out of This World 45100 Main St. Mendocino, CA 95460 Ph: (707) 937-3335 Fax: (707) 937-4046 www.ScienceTown.com	MN	Radio City 2663 County Road I Mounds View, MN 55112 Ph: (612) 786-4475 Fax: (612) 786-6513 www.radioinc.com	OK	Astronomics 680 SW 24th Avenue Norman, OK 73069 Ph: (800) 422-7876 Fax: (405) 447-3337 www.astronomics.com
		Scope City 730 Easy St Simi Valley, CA 93065 Ph: (805) 522-6646 Fax: (805) 582-0292 www.scopecity.com Call for additional locations		Brookside Science 330 W 63rd St Kansas City, MO 64113 Ph: (816) 523-4501		Hardin Optical 1450 Oregon Ave. Brandon, OR 97411 Ph: (541) 347-4847 Fax: (541) 347-2611 www.hardin-optical.com
		StarSafaris 1929 Esplanade Chico, CA 95926 Ph: (800) 870-3616 Ph: (530) 879-0207 Fax: (530) 345-6553 www.starsafaris.com		Lymax 13008 E US 40 Hwy Independence, MO 64055 Ph: (888) 737-5050 www.lymax.com		Cutler Camera Pennsylvania 7 locations in PA & NJ Ph: (800) 220-5727 Fax: (215) 674-0477 www.cutlercamera.com
		Woodland Hills Camera 5348 Topanga Canyon Blvd Woodland Hills, CA 91364 Ph: (818) 347-2270 Fax: (818) 992-4486 www.telescopes.net		Pocono West Optics 2580 S. Decatur, Suite K3 Las Vegas, NV 89102 Ph: (800) 635-3607 Fax: (702) 252-7130 www.PoconoScopes.com		Pocono Mountain Optics 104 NP 502 Plaza Moscow, PA 18444 Ph: (800) 569-4323 Fax: (570) 842-8364 www.PoconoScopes.com
National	CO	Wolf Camera & Video Ph: (800) 643-9653 visit www.wolfcamera.com for locations nationwide	NH	The Telescope Store 12 Main St Keene, NH 03431 Ph: (800) 550-7192 Fax: (603) 352-5119 www.telescopes-earth.com	TX	Analytical Scientific 11049 Bandera Rd. San Antonio, TX 78250 Ph: (210) 684-7373 Fax: (210) 520-3344 www.AnalyticalSci.com
		World of Science Ph: (800) 731-0079 visit www.worldofscience.com for locations nationwide		Edmund Scientific 101 E Gloucester Pike Barrington, NJ 08007 Ph: (800) 728-6999 www.edsci.com		Cooter's Village Camera 12 Highland Park Village Dallas, TX 75205 Ph: (214) 521-4553 Fax: (214) 521-9301
AR	DE	Astrostuff 1591 Pollard Rd Dover, AR 72837 Ph: (501) 331-3773 Fax: (501) 331-3131 www.astrostuff.com	NY	B & H Photo 420 Ninth Ave. New York, NY 10001 Ph: (800) 947-9954 Fax: (212) 444-6654 www.bhphotovideo.com	TX	Land Sea and Sky (Texas Nautical Repair) 3110 S Shepherd Dr Houston, TX 77098 Ph: (713) 529-3551 Fax: (713) 529-3108 www.Lsstnr.com
		Starizona 5201 N Oracle Tucson, AZ 85704 Ph: (520) 292-5010 Fax: (520) 292-5017 www.starizona.com		Clairmont-Nichols Optical 1016 1st Ave New York, NY 10022 Ph: (212) 758-2346 Fax: (212) 750-3583		Skywatch Products 7600 Benbrook Parkway, Suite #5 Benbrook, TX 76126 Ph: (817) 763-2895 Fax: (817) 249-5762 http://members.aol.com/skywatchpr/home.html
CA	IL	Fry's Electronics, Inc 600 East Brokaw Rd San Jose, CA 95112-1016 Ph: (408) 487-4500 Fax: (408) 487-4730 www.frys.com See website for locations	NY	Science and Hobby Emporium Rt. 299 New Paltz Plaza New Paltz, NY 12561 Ph: (800) 763-3212 www.scienceandhobby.com	TX	Whole Earth Provision Co. 1014 N. Lamar Blvd. Austin, TX 78703 Ph: (512) 476-1414 www.citysearch.com/aus/wholeearth
		Lumicon 6242 Preston Ave. Livermore, CA 94550 Ph: (800) 767-9576 Fax: (925) 447-9589 www.lumicon.com		Camera Corner 2273 S. Church St. Burlington, NC 27261 Ph: (336) 225-0251 Fax: (336) 222-8011 www.camcor.com		Anacortes Telescope 3202 Commercial Ave Anacortes, WA 98221 Ph: (360) 588-9000 Fax: (360) 588-9100 www.buytelescopes.com
CA	MA	Oceanside Photo & Telescope 1024 Mission Avenue Oceanside, CA 92054 Ph: (800) 483-6287 Ph: (760) 722-8133 www.optcorp.com	OH	McAlister Camera and Video 588 W. Schrock Rd. Westerville, OH 43081 Ph: (614) 794-1865 Fax: (614) 794-0502	WA	Captain's Nautical 2500 15th Ave West Seattle, WA 98119 Ph: (800) 448-2278 www.CaptainsNautical.com
		Orion Telescope Center 10555 S. De Anza Blvd. San Jose, CA 95112 Ph: (800) 447-1001 Fax: (831) 763-7017 www.telescope.com		Pete's PhotoWorld 7731 Beechmont Ave. Cincinnati, OH 45255 Ph: (800) 736-7383 www.photoworld.com		Eagle Optics 2120 W. Greenview Dr. #4 Middleton, WI 53562 Ph: (800) 289-1132 Fax: (608) 836-4416 www.eagleoptics.com
CA	MA	Hunt's Photo and Video 100 Main St Melrose, MA 02176 Ph: (800) 924-8682 Fax: (781) 665-4478 www.huntsphotoandvideo.com	OH		WI	



"NASA's recent action is definitely a big step back for the Pluto mission, but we think it is committed to the mission and committed to completing the reconnaissance of the solar system," says Doug Stetson, manager of the Solar System Exploration Office at the Jet Propulsion Laboratory in Pasadena, California. "The Pluto mission is not dead. Basically, what we're doing is returning it to a preproject formulation stage."

Stetson says that if the weight of the spacecraft is trimmed, a launch in 2014 would allow it (with a Jupiter assist) to arrive at Pluto by 2022. In addition, two new propulsion technologies under development — solar-electric propulsion and solar-sail technology — could be ready for a Pluto mission launch by 2010 to 2012 and possibly deliver a spacecraft to Pluto (without a Jupiter assist) by 2020. "We will look at those three options very carefully this year," says Stetson. "We think that will allow NASA and its science-advisory groups to make some intelligent mission decisions in the next couple years."

— REX GRAHAM

SOLAR ASTRONOMY

TRACE Turns Up the Heat

► Like children determined to burst the paper belly of a birthday piñata, solar astronomers are becoming a restless bunch. For nearly a century, they've been puzzled by the nature of the sun's corona — the tenuous, outer portion of the sun's atmosphere that dazzles



Stanford-Lockheed ISR and NASA

anyone who witnesses a total solar eclipse. But now they may be on the cusp of understanding how temperatures in the corona can soar to a blistering 3 million degrees Fahrenheit while the photosphere — the visible surface of the sun — lies beneath at a comparatively chilly 10,000 degrees.

While the exact nature of the coronal heating mechanism, which transports heat from the sun's interior to its outer atmosphere, remains unknown, Markus Aschwanden of the Lockheed-Martin Solar and Astrophysics Laboratory (LMSAL) and his collaborators report that they've successfully pinpointed a narrow region of the sun's atmosphere where the energy gets injected. If the findings of Aschwanden's team prove to be correct, the discovery places important constraints on potential mechanisms that should ultimately aid astronomers in finding the phenomenon responsible for coronal heating.

"The mysterious energy source that makes the sun's outer atmosphere so incredibly hot has been an enigma for more than 70 years, and before we discover what it is, we needed to learn where it is," explains Aschwanden.

The researchers used the high-resolution capabilities of NASA's Transition Region and Coronal Explorer (TRACE) spacecraft to view coronal loops with unprecedented clarity. Millions of coronal loops — filamentary structures that trace solar magnetic field lines — compose the sun's corona.

The standard view of coronal loops holds that these features are heated uniformly, from base to top. But according to Aschwanden's TRACE results, accepted for publication in the *Astrophysical Journal*, it appears that energy is actually injected at the base of the loops. In fact the results suggest that most coronal heating occurs very low in the corona, within 10,000 miles of the photosphere.

New results from the TRACE spacecraft show that coronal loops keep the same temperature throughout, suggesting that they must be heated from below.

The standard model of uniform heating predicts that the top of a coronal loop will be hotter than its base because the gas near the top is far more tenuous. Low-density gas has a much harder time cooling than high-density gas, so the tops of the loops should remain at a higher temperature.

But the new TRACE results suggest that coronal loops are really quite uniform in temperature from top to bottom. According to Carolus Schrijver, also with LMSAL and a member of Aschwanden's team, this can mean only one thing — coronal loops must be heated from below.

"Since a loop loses heat most rapidly from its base, most of the heat must also be going in at the base for the loop to be at a uniform temperature," says Schrijver.

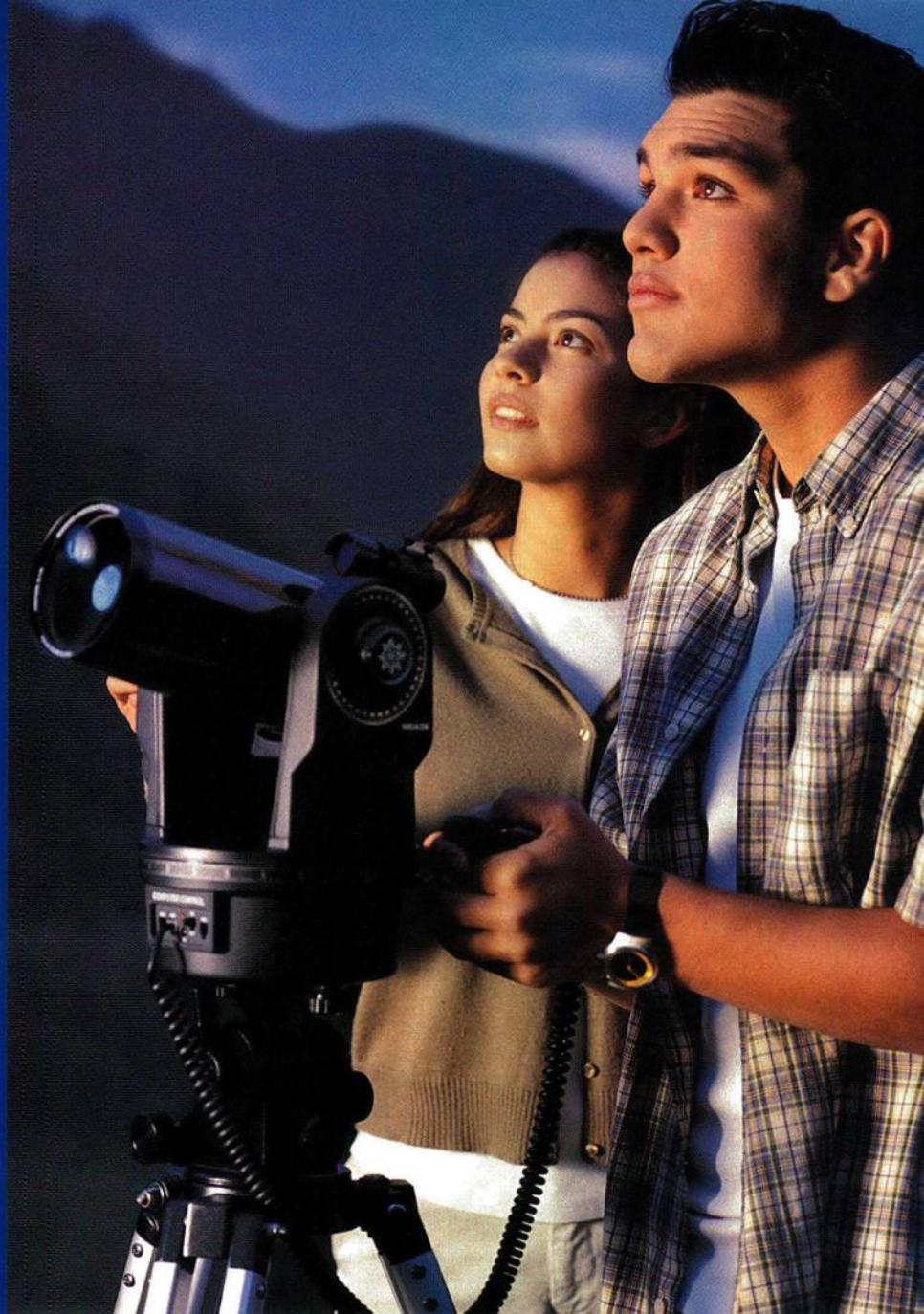


S T O R E TM

headquarters for
MEADE[®]
telescopes
and accessories

Win a Meade 8", 10" or
12" LX200 or an ETX-90EC!
Enter the Discovery Channel
Store Sweepstakes,
Oct. 25 - Dec. 17, 2000.
Details in stores.

See the complete collection of
Meade telescopes at your local
Discovery Channel Store.



ETX-60AT
\$299*



*plus sales tax and shipping, if applicable

ETX-90EC
\$595*



ETX-125EC
\$895*



For the store nearest you please call toll free 1-877-DCI-STORE
or order online at www.discoverystore.com



As is often the case with scientific endeavors, you don't have to look far for a dissenting opinion. This past summer, Eric Priest of St. Andrews University in Scotland authored a paper in the *Astrophysical Journal* that defended the standard model of uniform coronal heating. Unfortunately, it's too early to say which interpretation will ultimately prevail. To be sure, solar astronomers will continue to study the sun's corona so that they can better understand the processes that drive it and the coronae of other stars.

— WILLIAM SCHOMAKER

SPACE TECHNOLOGY

Imaging a Black Hole

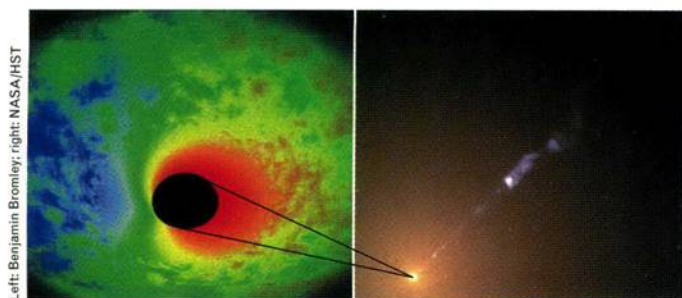
► Scientists from the University of Colorado in Boulder and from NASA's Marshall Space Flight Center in Huntsville, Alabama, have demonstrated that it is possible to build an x-ray telescope that would have unprecedented resolution — millions of times that of the Hubble Space Telescope. Such a telescope would be able to take pictures of the coronae

surrounding nearby stars as well as the hot gas swirling close to the event horizon of black holes. "I personally want to take a picture of Alpha Centauri," says team leader Webster Cash of the University of Colorado.

Today, the sharpest images of objects in the universe are made with radio telescopes. By combining the signals from two or more radio dishes spaced thousands of miles apart — systems called radio interferometers — astronomers routinely observe celestial objects with a resolution of just 0.001 arcsecond. This corresponds to seeing the disk of a dime at a distance of 2,000 miles. The signals from the different telescopes are combined and produce interference fringes from which images can be reconstructed. However, the wavelength of the light is also important — shorter wavelengths can yield sharper images even though the technical hurdles are more daunting.

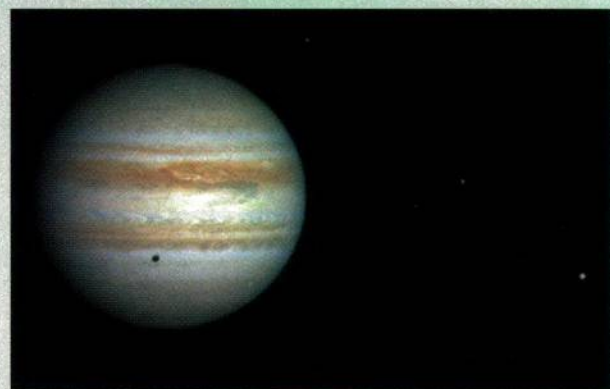
Although x rays have extremely short wavelengths, the sharpest images obtained with the Chandra X-ray Observatory are still far below the theoretical limit. X rays only reflect at grazing incidence — they would simply penetrate the surface of a typical telescope

A supermassive black hole powers the jet seen emanating from the core of the galaxy M87 (Hubble image, right). The proposed high-resolution MAXIM x-ray telescope should be able to image that black hole (left).



Left: Benjamin Bromley; right: NASA/HST

CASSINI SPACECRAFT



NASA/JPL/University of Arizona

DARK BELTS AND BRIGHT ZONES highlight the first color image of Jupiter taken by the Saturn-bound Cassini spacecraft. Photographed with Cassini's narrow angle camera through blue, green, and red filters, Jupiter's cloudtops appear close to their true color. The October 4 image, the first of many Cassini would return during the following three months, was taken from a distance of 50 million miles (81 million kilometers). The bright dot on the right side of the image is Europa — the large moon suspected of harboring a slushy ocean beneath its icy crust — and its shadow appears as the dark spot in Jupiter's southern hemisphere. Cassini will fly within 6 million miles (10 million km) of Jupiter on December 30, studying the planet's atmosphere, rings, and other features in conjunction with the orbiting Galileo spacecraft. The flyby will boost Cassini's speed, propelling it on to Saturn, where it will arrive on July 1, 2004.

mirror if striking it head on — and are extremely sensitive to even the smallest bumps in the x-ray optics.

So Cash and his team set out to build an x-ray interferometer using flat mirrors, which can be polished to a higher precision. Creating fringes with x rays proved a challenge, however. Even doing this with optical telescopes is much harder than with radio telescopes because of the exacting requirements for the optical systems, says Cash. (See "A New Year's Resolution," page 30.) The extremely short wavelengths of x rays, one nanometer compared with

500 nanometers for visible light, made creating an x-ray interferometer a formidable task. Nonetheless, "We were able to use some fairly standard components to work in a simple geometry to create the fringes," says Cash.

The team built a prototype of the x-ray interferometer in a 400-foot-long (120-meter) vacuum tank at the Marshall Space Flight Center. Two almost parallel mirrors reflected x rays coming from a source at one end of the tunnel to a second set of mirrors placed 1 mm apart. Those mirrors

Swinburne Astronomy Online

Swinburne Astronomy Online, the leading international online astronomy program, provides interactive astronomy education featuring custom-made CD-ROM material, newsgroup discussions lead by professional astronomers, low staff-student ratios, informed commentary on the latest astronomy headlines and projects tailored to suit the individual interests of participants.

Join participants from 22 countries already enrolled in Master of Science in Astronomy, Graduate Diploma of Science in Astronomy programs and individual subjects which are all online and accessible worldwide*. Swinburne Astronomy Online can be studied by anyone, anywhere, with a recent computer, Internet connection and most of all a keen interest in astronomy. Designed to complement the interests of amateur astronomers, science educators and science communicators generally, the program highlights the big issues in contemporary astronomy and emphasises conceptual understanding rather than mathematical detail.

* plus a Graduate Certificate in Science (Astronomy) program available in Australia only



©M.Bessell, MSSSO

US participant: *"I really love the Swinburne approach to the astronomy for non-astronomy career folks.*

Slow paced classes, humour, and the focus on learning as opposed to cramming. Even the tests were great.

I've NEVER taken a test before that was actually a learning experience, yet I'm finding that I'm learning a ton simply in the taking of these "assessments". If Swinburne was public, I'd buy stock in it. I think this is the way of the future and finally I'm excited about school again."



Swinburne Astronomy Online is produced by the Centre for Astrophysics and Supercomputing, one of the newest and most rapidly growing research centres in Australia. The Centre uses its supercomputer facility for astrophysics, virtual reality, scientific visualisation and public outreach and education including Swinburne Astronomy Online. The Centre has been involved in the discovery and timing of many of the southern millisecond pulsars, with major collaborators at the Australia Telescope National Facility, Caltech, Jodrell Bank and MIT.

It is located at Swinburne University of Technology in Melbourne, Australia.

Swinburne Astronomy Units*:

- | | |
|--|--|
| ■ Exploring the Solar System | ■ Astrophotography and CCD Imaging** |
| ■ Exploring Stars and the Milky Way | ■ Major Project - History of Astronomy** |
| ■ Exploring Galaxies and the Cosmos | ■ Major Project - Astrophotography and CCD Imaging** |
| ■ Theories of Space and Time | ■ Introduction to Particle Physics and High Energy Astrophysics*** |
| ■ History of Astronomy | ■ Introductory Stellar Astrophysics*** |
| ■ Introduction to Radio Astronomy and SETI | ■ Great Debates in Astronomy*** |
| ■ Tools of Modern Astronomy | |
| ■ Studies in Space Exploration** | |

*(Scheduling details given above are subject to change)

Available in 2001 *Available in 2002

For more information, visit www.swin.edu.au/astronomy/ or contact Dr. Margaret Mazzolini at email: astro@swin.edu.au fax: +61 3 9214 8797
airmail: BSEE, Mail Box 31, Swinburne University of Technology,
PO Box 218, Hawthorn VIC 3122 Australia

www.swin.edu.au/astronomy

SWIN
BUR
NE

CENTRE FOR
ASTROPHYSICS AND
SUPERCOMPUTING



sent the x rays 330 feet (100 meters) down the tank to a charge-coupled device, which recorded the x-ray fringe pattern. The resolving power of “that little, one millimeter baseline was slightly better than Hubble and several times better than Chandra,” says Cash.

The team is now investigating a larger design that actually could be used in space for astronomical observations. NASA is taking the x-ray interferometer design seriously and is now studying how to incorporate it in the Pathfinder project, reports x-ray astronomer Nicholas White, who is the project scientist for this project at NASA’s Goddard Space Flight Center in Greenbelt, Maryland.

Pathfinder, a “candidate mission” to be approved in about three years for a launch between 2008 and 2013, would consist of one spacecraft that will contain the x-ray mirrors with a baseline of 1.4 meters and a second spacecraft 500 kilometers away containing the detector. The resolving power would be more than 1,000 times that of the Hubble Space Telescope.

An even more ambitious project, called MAXIM (for MicroArcsecond X-ray Imaging Mission), would consist of a fleet of 32 spacecraft, each equipped with a mirror sending x rays down to a central detector. The mirrors, spaced up to 1,000 meters apart, would produce images with a resolution more than a million times that of Hubble. “A lot of technology still needs to be developed for the formation flying,” says White, “and it is still at least 20 to 25 years away.” —

ALEXANDER HELLEMANS

HUBBLE SPACE TELESCOPE



DELICATE TENDRILS INTERTWINE in the supernova remnant known as the Veil Nebula in the constellation Cygnus. This Hubble image, which covers just a tiny fraction of the nebula’s 3° extent, shows a region where the supernova’s blast wave is ramming into the surrounding interstellar gas. The collision takes place at nearly 400,000 miles per hour, releasing the tremendous amounts of energy needed to make the gas glow. By comparing this

Hubble image with a nearly 50-year-old ground-based photograph, astronomers were able to measure how far the blast wave had moved. By combining that distance with its known speed, they calculated that the Veil lies 1,500 light-years from Earth — far closer than previously thought. It also implies that the supernova explosion may have occurred only 5,000 years ago, providing our distant ancestors with a truly spectacular show.

GAMMA-RAY BURSTS

Another Record-Setting Burst

▶ In a blast from the past that would put a classic rock station to shame, astronomers have detected a powerful burst of gamma rays from the distant universe. The January 31, 2000, blast occurred in Carina and subsequent observations placed it farther away than any other burst yet seen, some 11 billion light-years from Earth.

The gamma-ray burst was discovered by a cluster of interplanetary spacecraft that together make up the Interplanetary Network. Currently consisting of four

spacecraft — NASA’s Near Earth Asteroid Rendezvous-Shoemaker and Wind, the joint NASA/European Space Agency’s Ulysses, and the Italian BeppoSax — the network can quickly pinpoint a gamma-ray burst.

At first no one thought this burst was anything special. After all, gamma-ray bursts occur about once a day and this one wasn’t particularly bright. A team of European astronomers then went to work, using the European Southern Observatory’s Very Large Telescope to hunt for the burst’s optical afterglow.

The researchers found that the light from the object appeared very red, a good indication that the burst lay far away and that the expan-

sion of the universe had shifted its light to the red. Spectra of the afterglow confirmed the hunch — the light had been shifted by a factor of 4.5, placing the burst roughly 11 billion light-years away.

To be seen from Earth, the burst must have been at least one trillion times as bright as the sun, or thousands of times brighter than a supernova. The astronomers are now studying the burst’s surroundings, hoping to observe the properties of its host galaxy. So far, they have had little success — not too surprising because the galaxy itself is at least 10,000 times fainter than the burst.

Only by studying many more gamma-ray bursts will astronomers learn what

Does the night sky leave you in the dark?

Answer the following questions to determine your intergalactic know-how.
(Hint: Download a FREE trial version of Starry Night™ at www.StarryNight.com and cheat.)

1. The "Trifid" is a what?

- a. Galaxy
- b. Nebula
- c. Globular Cluster
- d. B-movie monster

2. What is the most distant object you can see with the naked eye?

- a. Pluto
- b. The Andromeda Galaxy
- c. Crab Nebula
- d. Isn't that against the law?

3. What are globular clusters?

- a. Space dust
- b. Twin asteroids
- c. Balls of closely packed stars
- d. Mom's Awful Cookies

4. Comet Halley is visible from Earth once every how many years?

- a. 52
- b. 24
- c. 76
- d. Hup, Hup, Hup

5. Galilean moons orbit which planet?

- a. Mercury
- b. Jupiter
- c. Hollywood

6. The sun travels through how many constellations in one year?

- a. 6
- b. 12
- c. 13
- d. The sun moves?

7. Where is M31?

- a. Andromeda
- b. Perseus
- c. Near Chicago

8. What is another name for the North Star?

- a. Polaris
- b. Sirius
- c. Celine Dion

9. Which of the following isn't a nebula?

- a. Crab
- b. Veil
- c. Orion
- d. Moose

ANSWERS:

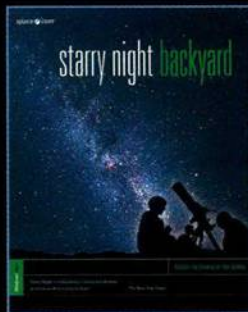
1(b), 2(b), 3(c), 4(c), 5(b), 6(c), 7(a), 8(a), 9(d)

Let Starry Night™ be your guide.



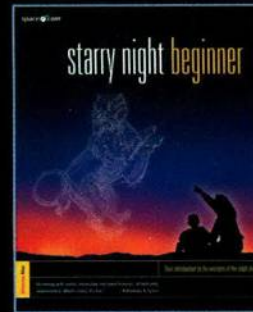
starry night pro. Advanced software for the experienced astronomy enthusiast. Visually stunning, this CD has all the data you need to guide you to all the planets, stars, constellations and over 70,000 galaxies. Comes complete with a free 200 page guidebook to navigating the stars.

➤ Starry Night Pro \$129.⁹⁵



starry night backyard. Discover the Universe on your desktop. Sharing the same visual accuracy as Starry Night Pro, this CD will help you identify planets, stars and constellations using binoculars or the naked eye. Backyard (SE) also comes with the free 200 page guidebook.

➤ Starry Night Backyard \$49.⁹⁵ ➤ (SE) \$59.⁹⁵



starry night beginner. Your introduction to the wonders of the night sky. Starry Night Beginner conveys the invigorating experience of being out in the countryside standing under a canopy of stars on a still night. It's perfect for anyone learning their way around the night sky.

➤ Starry Night Beginner \$29.⁹⁵

Order now from www.StarryNight.com or call (800) 221-8180

Take an online tour at www.StarryNight.com/tour

Starry Night is now published by **space.com**

causes them. Many believe they result when a massive, short-lived star dies in a titanic explosion. Dubbed hypernovae to differentiate them from their more sedate cousins, the supernovae, these explosions could easily be seen across the universe. Another idea holds that the bursts originate when two neutron stars collide. Both theories may be right, but we won't know for sure without more detailed observations.

The study of gamma-ray bursts took another leap forward on October 9 with the launch of the High-Energy Transient Explorer (HETE-2) spacecraft. Scheduled for a four-year mission, HETE-2 should detect hundreds of bursts and provide detailed information on their locations and characteristics. Within seconds, it will calculate a burst's precise position and relay it to the ground, where it will be transmitted worldwide in 10 to 20 seconds. The quick turnaround will allow astronomers to observe a burst while it's occurring and study its development at all wavelengths. — RICHARD TALCOTT

STELLAR DISTANCES

A New Year's Resolution

▶ These days, it isn't often that significant astronomical research gets done with 16-inch telescopes. What's more, it's not often that a graduate student acts as the lead investigator for such a project. Nevertheless, Caltech graduate student Benjamin Lane and his collaborators have measured the distance to a bright Cepheid variable star with unprecedented accuracy. In the September 28, 2000, *Nature*, the team reports that Zeta Geminorum — one of the four brightest Cepheids in the northern sky — lies 1,100 light-years from Earth.

Although Zeta Gem is just one star, this achievement underscores the previously untapped potential of optical interferometry to reduce the errors involved with measuring fundamental

This gamma-ray burst (arrow) lay 11 billion light-years from Earth.

MMT FIRST LIGHT



Serge Brumier (Ciel et Espace)

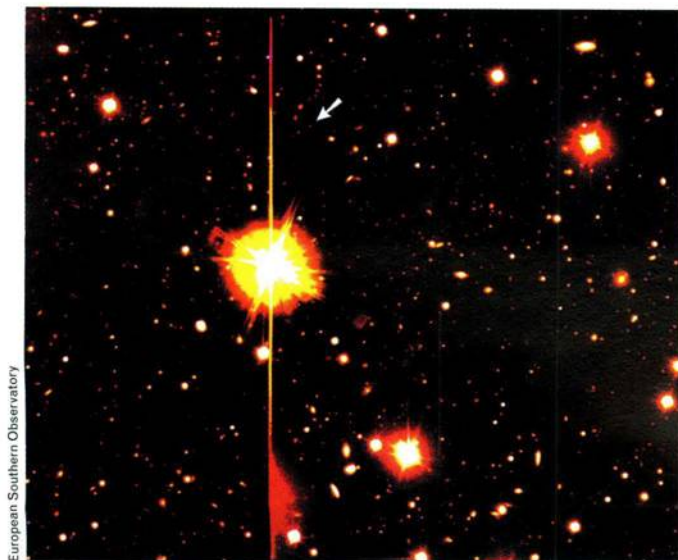
A MULTIPLE-MIRROR TELESCOPE NO MORE, the new telescope of the MMT Observatory will return it to the forefront of astronomical research. The original MMT (which stood for Multiple-Mirror Telescope) consisted of six 1.8-meter mirrors in a single mount (left photo), equaling the light-gathering power of a single 4.5-meter mirror. That made it the third-largest optical telescope in the world when it was dedicated in 1979 on Mt. Hopkins, Arizona. "The original telescope changed people's expectations of how a telescope should be designed and how a modern telescope should perform," says MMT Director Craig B. Foltz. Unfortunately, the 4.5-meter mirror no longer rivaled the big new telescopes coming online. The University of Arizona and the Smithsonian Institution decided to replace the array with a single 6.5-meter mirror (right photo) cast at the UA Steward Observatory Mirror Lab. The new instrument gathers 2.5 times more light than the old and extends the field of view 15 times.

cosmological parameters such as the Hubble constant — the ratio of a galaxy's velocity resulting from the expansion of the universe to its distance from Earth.

The Palomar Testbed Interferometer (PTI) uses twin 16-inch telescopes and the latest computing and engineering technology to achieve the angular resolving power of a single 360-foot mirror. With it, the team directly observed variations as small as 50-billionths of a degree in Zeta Gem's diameter throughout the star's 10.2-day pulsation period. Taking the ratio of the star's physical change in diameter, a result that they culled from earlier data, to its corresponding angular change in

diameter, Lane and his colleagues found Zeta Gem lies at a distance of 1,100 light-years with an error of only 15 percent. This represents a three-fold improvement over all previous attempts to measure the distance.

With high resolving power and relatively low light-gathering power, optical interferometers are ideally suited to detecting small movements in fairly close objects. That makes this method a powerful tool for finding the signature of a large planet orbiting a nearby star or measuring the regular pulsation of a Cepheid variable. But until now, prohibitive engineering challenges have hindered the widespread use of



European Southern Observatory

F. C. Meichsner Co., Inc.

Our 81 years of experience and knowledge will help you get the best optics for your money!

- | | | |
|-------------|------------|----------------------|
| ☆ Celestron | ☆ Miyauchi | ☆ Used Equipment |
| ☆ Meade | ☆ Fujinon | ☆ Repair Service |
| ☆ Tele Vue | ☆ Nikon | ☆ Large Showroom |
| ☆ Takahashi | ☆ Swift | ☆ Worldwide Shipping |
| ☆ Questar | ☆ Bushnell | ☆ Free Price List |

☆ Accessories Always in Stock • Call for Monthly Specials

Call us at: (800) 321-VIEW! (8439)

Fax: 617-426-0837 (24 hours)

E-Mail: Meichs@aol.com

Visit us at: 182 Lincoln Street, Boston, MA 02111

Web site: <http://www.meichsner.com>

CELESTRON

REFRACTORS

60 Altazimuth.....	\$99
60 Equatorial.....	\$159
80 Equatorial.....	\$349
C102-HD.....	\$549
CR-150-HD.....	CALL

REFLECTORS

Table Top 76.....	\$99
76 Equatorial.....	\$159
114 Firstscope.....	\$299
114 Short.....	\$229
C150-HD.....	\$549
6" Star Hopper.....	\$319
8" Star Hopper.....	\$399

NEXSTARS

NexStar 60-GT.....	\$299
NexStar 80-GT.....	\$399
NexStar114-GT.....	\$499
NexStar 5.....	\$1199
NexStar 8.....	\$1699

SCHMIDTS

G-5.....	\$699
G-8.....	\$999
Celestar 8.....	\$1099
Deluxe.....	\$1699
Ultima 2000.....	\$2699
G-9.25.....	\$1349
CM-1100.....	CALL
CM-1400.....	CALL

EYEPIECES

Plossl 3.6, 6, 8, 10.....	\$39
Plossl 13, 17, 25.....	\$39
Plossl 32, 40.....	\$59
Ultima 5, 7.5, 12.5.....	\$79
Ultima 18, 36.....	\$89
Ultima 35, 42.....	\$109
LV 6, 10.....	\$105
LV 5, 9, 15.....	\$105
LV 2.5, 4, 12.....	\$116
AXIOMS.....	CALL

NEW ASTRO OPTICS PRODUCTS

**WORLD'S
LARGEST
BINOCULARS**
30 x 180
\$4,999

REFRACTORS

- Achromatic Objective
 - Heavy Duty EQ Mount
 - Aluminum Tripod
 - 26mm Super Plossl
 - 90° Star Diagonal
 - 6X30 Finder Scope
- 120mm f/8.3.....\$549
127mm f/8.9.....\$799

VISIT US
ON
THE WEB!

ASTRO STUFF

Mid-America's Largest Astronomy Showroom!
www.astrostuff.com

Info: (501) 331-3773 • Order: 1-877-739-2787 • FAX: (501) 331-3131

1591 Pollard Road, Dover, Arkansas 72837

SECURE
ONLINE
ORDERING!

STOCKING MEADE DEALER

What in the World

ORDER TOLL FREE (888) 942-8967

Blowout Inventory Liquidation Sale

Save Up to 70%

Accu-Focus™?

What in the World has developed (pat. pend) this got-to-have tool for collimating your optics, making tack sharp CCD images possible and even enhancing planetary viewing with SCTs and Newtonians! And it performs these feats at a bargain price. The 8" SCT Accu-Focus™ starts at just ~~\$39.95~~.

Now starting at just \$25.00.

WE OFFER COMPUTERIZED ASH
OBSERVATORY DOMES

Limited stock of Tele Vue and Takahashi
telescopes and accessories

Want an ADVANCED Meade telescope?

What in the World can provide you with the full line of Meade telescopes and accessories. We stock small refractors, most sizes of Dobsonians, GOTO computerized 90 and 125mm scopes and the highly acclaimed SCTs. We specialize in Meade's computerized telescopes.



We've never sold these telescopes for less!



Do you want a Celestron SCT?

As a Showcase dealer, What in the World provides the full line of first class Celestron optics at competitive prices. From the popular Celestar series to the Ultima 2000 GOTO scope to the complete series of German equatorially mounted SCTs G3, G5, G8, CM1100 and CM1400, we stock most models. We also stock the amazing NEW NexStar Series with GOTO capability in an ultra-portable package.



Call for sale prices on items in stock!

OPEN 7 DAYS 10AM-6 PM PST

PO Box 1767, Lake Arrowhead, CA 92352

Information (909) 337-5080 Fax: (909) 336-9708

\$6 Minimum freight. Freight charges are nonrefundable. Restocking charges may apply to returns for credit or to items returned used or damaged. Prices subject to change without notice.

Over 200 pages of
telescopes, eyepieces and resources.

www.StarSafaris.com



The Palomar Testbed Interferometer has measured the distance to the Cepheid variable star Zeta Geminorum at 1,100 light-years.

interferometry at optical wavelengths. (With the longer wavelengths of radio waves, for decades astronomers have been exploiting the high-resolution capabilities of interferometers such as the Very Large Array and the Very Long Baseline Array.)

At the turn of the 20th century, Henrietta Leavitt discovered a direct relation between a Cepheid's pulsation period and its intrinsic brightness, or luminosity. And because astronomers can easily observe a Cepheid's pulsation period as well as its apparent brightness, they need only compare the star's calculated luminosity with its apparent brightness to determine the star's distance.

Without Cepheids to judge the distance of relatively nearby objects, astronomers would be unable to determine distances to remote galaxies. Consequently, perhaps more than any other type of astrophysical object, Cepheids play a key role in determining the size, age, and fate of the universe.

But like many other empirical trends, the period-luminosity relation for Cepheids comes laden with uncertainty. Because Lane's measure of the distance is independent of the period-luminosity relation, however, it and future measurements may help reduce that uncertainty.

Lane and his colleagues hope that their recent success with the PTI will be a prelude to even bigger success with several optical interferometers scheduled to come online soon. The Center for High Angular Resolution Astronomy is a 1,300-foot, six-telescope interferometer array that should see first light atop Mount Wilson in California by the beginning of January. "The excitement is that the technique does work. As other optical interferometers come online, they will produce a dozen similar measurements with accuracy to a few percent," says Caltech's Shri Kulkarni, Lane's research advisor and one of his coauthors.

The PTI serves as an engineering testbed for an even more ambitious project that will link the twin 10-meter Keck telescopes on Mauna Kea in Hawaii. — W.S.

A

Here's SALT in Your Eyes

Groundbreaking ceremonies took place on September 1, 2000, in Sutherland, South Africa, for one of the largest telescopes in the Southern Hemisphere. The South African Large Telescope, or SALT, is an international venture with sponsors from South Africa, Germany, New Zealand, Poland, the United Kingdom, and the United States. The 82-ton SALT incorporates 91 identical hexagonal mirrors in an array that measures 11 meters by 10 meters. Its design will be based on that of the Hobby-Eberly Telescope in West Texas, with a fixed axis tipped 37° to the vertical. Astronomers expect to see "first light" in 2003, and SALT should become fully operational by 2005.



The 10-meter by 11-meter South African Large Telescope will rank among the biggest in the world.

Spacewatch Scope Doubles in Size

Since 1984, University of Arizona astronomers working on the Spacewatch Project have been electronically scanning the sky for asteroids. Using a 36-inch telescope on Kitt Peak, the researchers have discovered tens of thousands of asteroids and more than 200 of the near-Earth variety — those that may pose a risk to our planet. Yet originally Tom Gehrels and Robert McMillan hoped to use a 72-inch telescope instead of the 36 inch. In September, they finally got their wish. The new Spacewatch Telescope will be able to see down to magnitude 22.7, 2½ times fainter than with the old one, and should discover twice as many asteroids. The old scope will be upgraded and eventually added to the project.

Fourth Light for Very Large Telescope

Most observatories celebrate when a telescope achieves "first light," the initial pointing of the scope to the sky. For the scientists and engineers at the European Southern Observatory in Chile, however, the night of September 3, 2000, proved much worthier of celebration. That was the night when, after nearly 15 years of labor, the fourth and final unit of the observatory's Very Large Telescope (VLT) came online. Named Yepun (which means "Venus" in the local Mapuche language), the new telescope joins with Antu, Kueyen, and Melipal to form the most advanced telescope on Earth. On September 3, four teams of astronomers sat at computer terminals operating each of the 8.2-meter telescopes separately. Beginning in 2001, some of the four will be linked to form the VLT Interferometer, which will provide unparalleled sensitivity and image sharpness.



WITH CANON IMAGE STABILIZER BINOCULARS YOU CAN LOOK AT THE LUNAR SEAS WITHOUT GETTING SEASICK.

(And the price is very down to earth.)

It's a night so clear you feel as if you can almost touch the moon. But when you lift your high-powered binoculars, you wonder why the earth suddenly has more than one moon. It's your binoculars. Hand-holding high magnification binoculars can only lead to jumpy, shaky images. Next time, bring along a pair of Canon 18X50 IS Image Stabilizer Binoculars. Their microprocessor-controlled Vari-angle prisms instantly shift and countershift to compensate for shaky hands, turning you into a



Without Image Stabilization



With Image Stabilization

human tripod. So everything you see will be clear and stable. Now you can catch a comet by the tail. Make distant star clusters stay firmly in focus. And save a lot of money, since our Image Stabilizer Binoculars are well within any astronomer's budget. See the complete range of Canon Image Stabilizer Binoculars including our 15X50's, and our other binoculars, at your authorized local Canon dealer.

Canon
KNOW HOW™

exploration destination

The holiday season is a perfect time for star gazing. That's why at eHobbies, we've stocked our store with telescopes, binoculars, star charts and more. Shop on your own time, we'll deliver your order right to your doorstep.



Star Hopper 4 1/2 Telescope
by CELESTRON
The Dobsonian reflector telescope is a recent design that places all the performance of the Newtonian reflector design on a simple altazimuth mount. Celestron's Dobsonian design, the Star Hopper, is great for beginners because it's very easy to use and quite economical, yet has advanced features even an experienced observer will appreciate.
eHobbies price: \$193.99
Item #1004-1128



Nexstar 114 GT Reflector
by CELESTRON
The NexStar 114 Newtonian reflector has 265 times the light gathering power of the average human eye, revealing fine detail within galaxies and nebulae. This compact design brings objects into view with a 114mm aperture, 1000mm focal length capable of achieving magnifications of 40x and 100x with the included eyepieces.
eHobbies price: \$499.99
Item #1006-0038



▲ Nexstar 60 ST Refractor
by CELESTRON
eHobbies price: \$189.99
Item #1006-0032



▲ Nexstar 80 GT Refractor
by CELESTRON
eHobbies price: \$399.99
Item #1006-0036

▼ 8" NexStar Telescope
by CELESTRON
eHobbies price: \$1,699.99
Item #1003-9772



▼ C102-HD Refractor Telescope
by CELESTRON
eHobbies price: \$499.99
Item #1003-9769



▲ 102mm Wide View Spotting Scope
by CELESTRON
eHobbies price: \$357.99
Item #1004-1327

▼ 100x4.5" Voyager Compact Telescope
by BUSHNELL
eHobbies price: \$189.99
Item #1004-1786



▲ Firstscope 80 EQ Telescope
by CELESTRON
eHobbies price: \$349.99
Item #1004-1106



▼ 8x56 Ultima Series Binocular
by CELESTRON
eHobbies price: \$259.99
Item #1003-9767



▲ 10x50 Enduro Series Binocular
by CELESTRON
eHobbies price: \$49.99
Item #1004-1204



▲ TableTop 76 Newtonian Telescope
by CELESTRON
eHobbies price: \$99.99
Item #1004-1114

we carry products from these great manufacturers...

Celestron, Fujinon, Bushnell, Zeiss, Kalmbach, Meade, Pelican Products, Sienna Software, Sky Publishing and more.

hot deals

Find amazing deals on optics, media and accessories in our **hot deals** area anytime.

1-888-eHobbies

**order by phone –
24 hours a day, 7 days a week**



▲ Barlow Lens Ultima
Celestron 2 X 1.25"
by CELESTRON
eHobbies price: \$69.99
Item #1004-1472



▲ Focal Reducer/Corrector
Celestron F/6.3
by CELESTRON
eHobbies price: \$119.99
Item #1004-2257



▲ Starry Night Backyard
Astronomy Software
by SPACE.COM
eHobbies price: \$59.99
Item #1004-0653

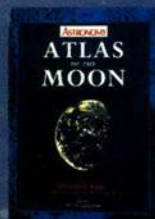
▼ Slik 504 QFII Tripod
by SLIK
eHobbies price: \$129.99
Item #1004-4395



▼ 1300 Eyepiece Accessory Case
by PELICAN PRODUCTS
eHobbies price: \$58.99
Item #1004-3412



▼ Atlas of the Moon
by KALMBACH
eHobbies price: \$34.95
Item #1004-2322



gift shop

Our **Gift Shop** is filled with items sure to provide holiday cheer for any astronomer. Choose from our wide selection of optics and accessories for beginners or buy a gift certificate for the astronomy expert.



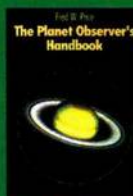
80mm Wide View
Spotting Scope
by CELESTRON
eHobbies price: \$199.99
Item #1004-1164



G-5 Schmidt-
Cassegrain Telescope
by CELESTRON
eHobbies price: \$699.99
Item #1004-1133

wish list

Wish someone would buy you the perfect gift? Visit our **Gift Shop** to create a list of items you want, so friends and family know exactly what to get you this holiday season.



The Planet Observer's Handbook
by SKY PUBLISHING
CORPORATION
eHobbies price: \$19.95
Item #1004-5505



7x50 Ultima Series Binocular
by CELESTRON
eHobbies price: \$239.99
Item #1004-1217

BINOCULARS & ACCESSORIES

Item #	Description	Manufacturer	Price
1004-3315	20x80 Satellite Binocular	Swift Instruments, Inc.	509.99
1004-1218	10x50 Ultima Series Binocular	Celestron	239.99
1004-1202	7x50 Enduro Series Binocular	Celestron	44.99
1004-2955	VSP (Vibrations Suppression Pads)	Celestron	41.99
1004-2897	Piggyback Mount - C8, 9-1/4, 11 & 14	Celestron	32.99
1004-2248	Binocular Tripod Adapter	Celestron	19.99

TELESCOPES & ACCESSORIES

Item #	Description	Manufacturer	Price
1004-1135	5" NexStar Schmidt-Cassegrain Telescope	Celestron	1199.99
1006-0200	Firstscope 80 EQ Telescope	Celestron	349.99
1006-0201	Firstscope 114 Telescope	Celestron	299.99
1006-0198	Firstscope 76 EQ Newtonian Telescope	Celestron	159.99
1004-2566	Equatorial Mount - CG-5	Celestron	422.99
1004-2253	Flashlight, Night Vision	Celestron	19.99
1004-2655	Adapter DC, Car Bttry, U2000/Nexstar 5/8	Celestron	15.99

*All prices are subject to change.

ASTRONOMY MEDIA

Item #	Description	Manufacturer	Price
1004-3430	Advanced Skywatching	Sky Publishing Corp	29.99
1004-3435	Astronomy For Dummies	Sky Publishing Corp	19.99
1004-5285	CD Rom The Sky	Celestron	14.95
1004-5512	The Deep Sky (An Introduction)	eHobbies	24.95

ASTRONOMY SUPPLIES

Item #	Description	Manufacturer	Price
1004-1472	Barlow Lens Ultima Celestron 2 X 1.25"	Celestron	69.99
1004-1273	Eyepiece Filter Set 1-1/4 (8,15,47,82A)	Celestron	44.99
1004-2260	Tripod Nexstar 5	Celestron	199.99

**We are an authorized
dealer of Meade products.**

www.eHobbies.com

AOL Keyword: eHobbies

eHobbiesSM

creating a new world for hobbyistsSM

DISCOVERING COSMIC RAYS

*Millions of years old,
cosmic rays were unknown only a century ago.*

by James Trefil

It was born millions of years ago in a distant galaxy, accelerated to incredible speeds by a process unknown to science. For millennia it sped through the void, twisting and turning in the magnetic fields, passing through the emptiness that separates one galaxy from another. Then, one day, near an ordinary sun in a region of an ordinary galaxy, something extraordinary happened. On October 15, 1991, it plowed into Earth's atmosphere, somewhere above the Utah desert. The first atom it struck, high in the atmosphere, blew apart, its fragments hurtling downward with almost as much speed as the thing that hit it. These fragments, in turn, smashed into other atoms and broke them apart. In a fraction of a second, a downward flowing cascade developed, with each new fragmented atom giving rise to particles and fragments that, in turn, produced more of their kind. By the time this flood reached the ground, it contained hundreds of billions of particles and extended across hundreds of square miles of land.

Down near the surface, another extraordinary thing happened. Some of the particles collided with nitrogen atoms in the atmosphere, causing them to give off ultraviolet radiation ("black light"). That light, in turn, triggered measuring instruments that had been put in place by an international team of scientists. To those instruments, bearing the evocative name of "Fly's Eye," the shower looked like an

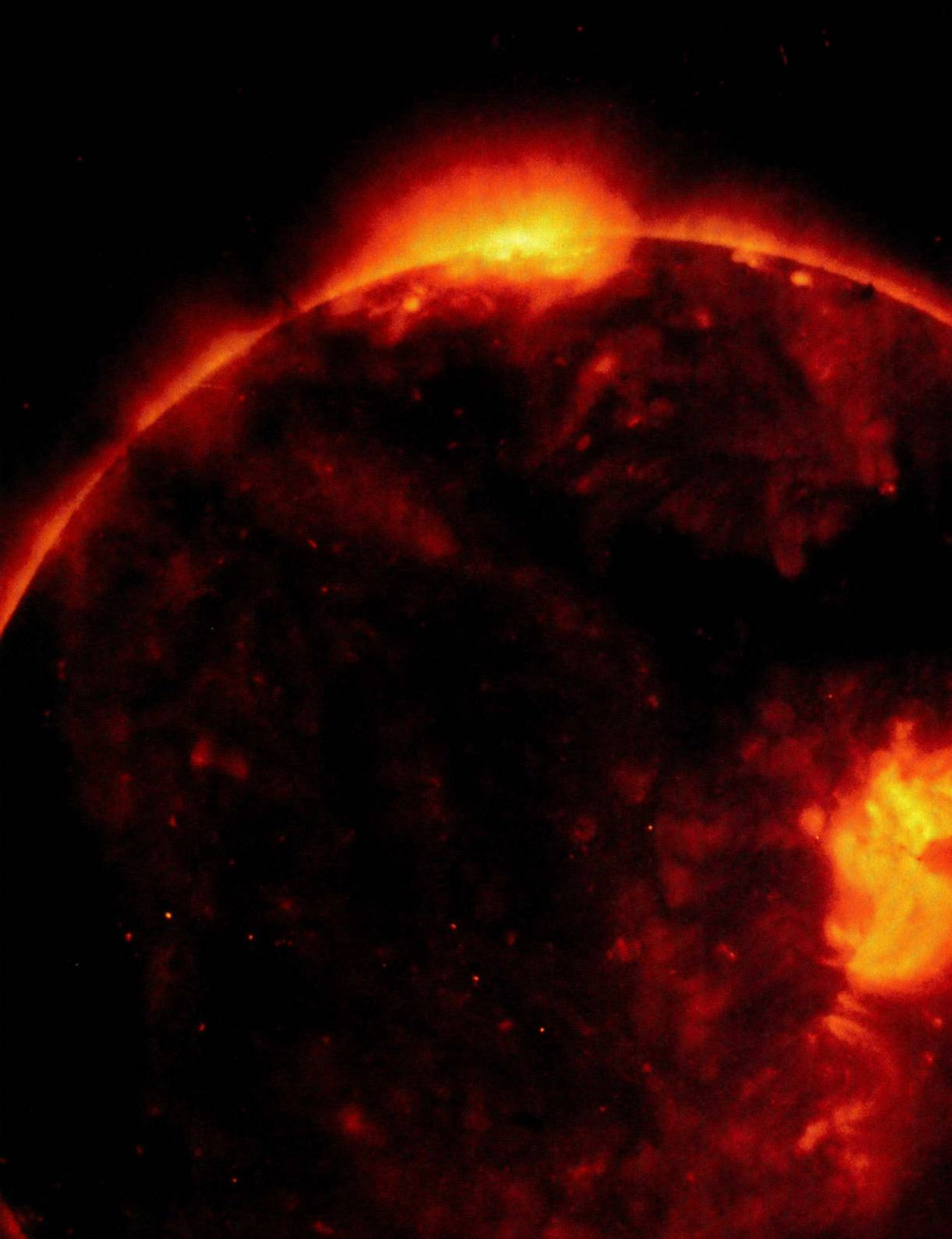
impossible streak of paint across the night sky. After they had analyzed the readings of those instruments, the scientists announced that they had recorded the arrival of the most energetic particle ever seen by human beings.

The story I've just told you is the life history of something known as a cosmic ray. Produced in stars, cosmic rays have been raining down on Earth since before the dawn of history. They are, in fact, the only bits of solid matter that come to us from the far reaches of the universe.

Cosmic rays are not rare at all. In fact, particles created in their collisions with Earth's atmosphere are passing through your body as you read this and have been doing so since the day you were born. Every year someone living at sea level absorbs as much energy from cosmic rays as they would get from a couple of chest x rays, and people at higher altitudes absorb even more.

Most cosmic rays are mundane things, ordinary particles such as protons and electrons, although the nuclei of heavy atoms are occasionally seen. The debris from their collisions in the atmosphere rains down on the surface of Earth at the rate of about a dozen per second on each square foot of area. They first came to attention of scientists around the turn

The lowest energy cosmic rays come with the production of giant solar flares. SOHO



of the century, when it was noted that delicate electrical equipment seemed to be absorbing electrical charge, even when it wasn't connected to a circuit and was well shielded from the outside. At the time, people assumed that this effect was due to charged particles given off by the radioactive decay of atoms. (Radioactivity had recently been discovered.)

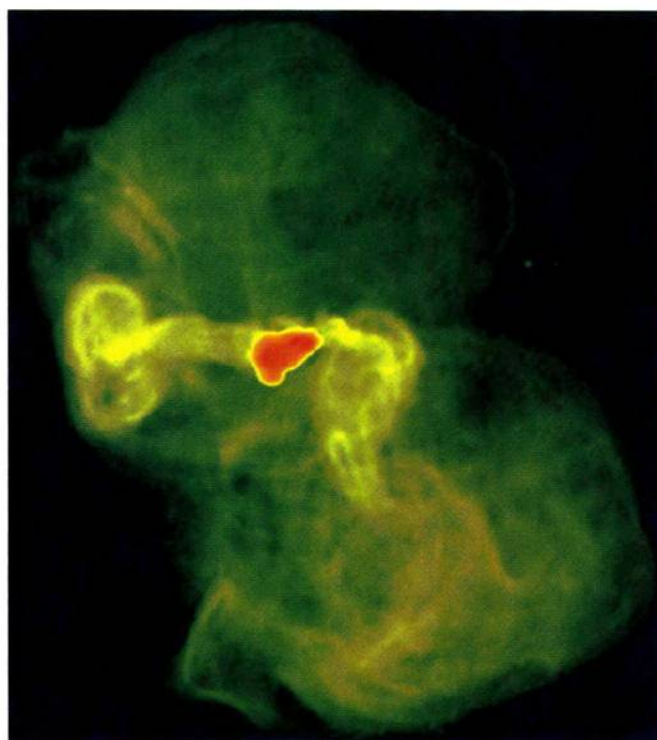
In 1910, however, this simple notion changed because of experiments done in an unusual venue. A Swiss scientist by the name of Andreas Gockel took some measuring instruments up in a balloon, and, at 13,000 feet, he found that the instruments were absorbing even more charged particles than they did on the ground — exactly the opposite of what you'd expect if the source of the particles were radioactive materials in the soil and rocks. Over the next few years, further balloon flights, most notably by German Nobel Laureate Victor Hess, fleshed out our knowledge of these mysterious charged particles. Hess found, for example, that the rate of absorption of charge didn't seem to vary much from night to day, which meant at least some of the particles had to come from a place other than the sun.

By the mid-1930s, scientists had pretty well established that whatever these mysterious particles were, they had to originate somewhere out in space. The field of "cosmic-ray" science was born, and three questions started to be asked, none of which has ever been completely answered. The questions are (1) if they don't come from Earth, where do cosmic rays come from, (2) what are they, and (3) how did they get all that energy?

Solar Flares Send Cosmic Rays

The most familiar particles from space are those that compose the so-called solar wind, a flood of protons and electrons from the sun that sweeps by Earth at a speed of around 300 miles per second. It compresses Earth's magnetic field on the "upstream" side and pulls it out on the "downstream," blows comets' tails out in back of them, maintains the Van Allen Belts above Earth, and helps supply energy for the aurora borealis (northern lights). Although solar wind particles are moving swiftly by human standards, they travel at only a tiny fraction of the speed of light and aren't usually dignified by the term cosmic rays.

To be a cosmic ray, a particle has to be moving at an appreciable fraction of the speed of light (186,000 miles per second). Some cosmic rays are produced in the sun, when huge chunks of hot plasma rear up from the surface to create solar flares. Cosmic rays produced by these flares are the same stuff as the solar wind — ordinary protons and electrons —



Jets that stream out from what is thought to be a black hole in the center of M87, an elliptical galaxy, carry with them high-energy cosmic rays. Very Large Array

but they are moving much faster. (The x rays and ultraviolet radiation associated with solar flares often cause disruptions of radio transmissions when they arrive at Earth.)

But most of our visitors come from a lot farther away and have more energy than these neighborly particles that come from the sun. Scientists usually discuss the energy of cosmic rays in a unit called the electron-volt, abbreviated "eV." One electron volt is the amount of energy required to push one electron across the poles of a one-volt battery. In this unit, it takes about one and a half eV to push an electron across the poles of a flashlight battery, 12 eV to push it across the poles of a car battery, and 115 eV to move it from one side of an ordinary wall plug to another. Roughly speaking, it takes tens of eV to move electrons around in an atom and millions of eV to move stuff around inside that atom's nucleus. It is not uncommon for solar flares to produce cosmic rays with energies in the range of

BALLOON SCIENCE

Doing science in balloons wasn't always easy. In 1934, for example, a trio of Americans launched a balloon called Explorer I from the Black Hills in South Dakota. The balloon was filled with hydrogen to give it extra lift — the same stuff used in the ill-fated dirigible Hindenberg. At about 60,000 feet, the bag ripped and the balloon, along with the airtight cabin underneath, started a rapid descent. The crew was too far above the ground to use parachutes, so it just had to wait as the balloon plunged downward. The fabric of the balloon quickly formed a kind of parachute, slowing the fall and allowing time for air to mix dangerously with

the hydrogen. At 3,000 feet, just as the crew members were getting ready to jump, the balloon exploded. The men were able to get out, and on the way down in their own parachutes, they watched their blazing gondola crash and burn beneath them. They must have had the right stuff, because the same crew went up in Explorer II 18 months later and set an altitude world record of more than 60,000 feet. Everything on this flight went fine until just before the landing, when the balloon ripped open and covered the gondola. Once again, luck was on the crew's side and everyone got out safely. —J.T.

tens of millions of eV. This is the sort of energy produced by the machines used in modern hospitals for radiation therapy.

But cosmic rays come in energies higher than this — so much higher, in fact, that scientists speak of the energies in terms of a unit called the GeV, which is a billion electron volts. (The “G” stands for “giga.”) In terms of this unit, the highest energy cosmic rays from the sun weigh in at a paltry 0.01 GeV, and we know about some cosmic rays that have energies around 100 billion GeV, a “cosmic” energy indeed.

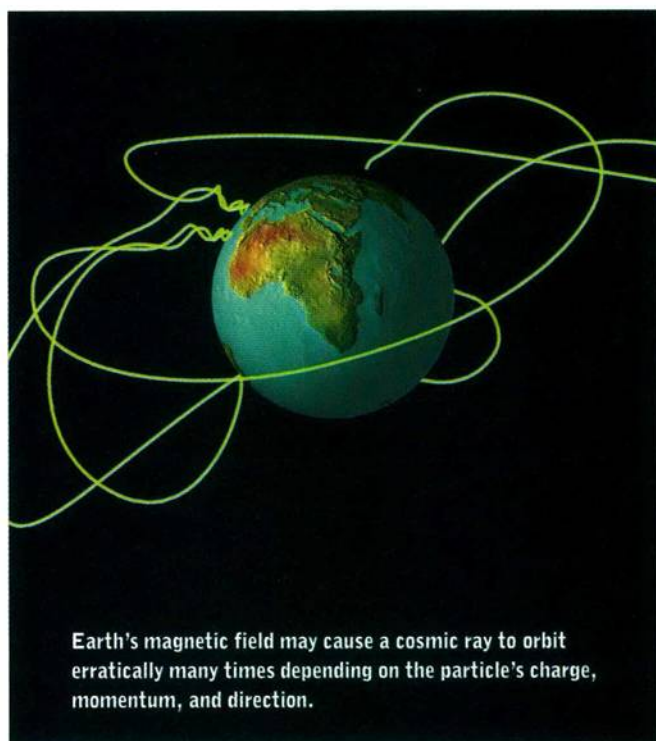
The emptiness of space both inside and outside the solar system is filled with the lines of magnetic fields, and when charged particles such as cosmic rays encounter them, the particles start to follow a corkscrew-like path. If the field is strong enough, or if the particle is moving slowly enough, the path of the particle will twist many times around the field lines and the particle can find itself trapped. If, on the other hand, the field is weak or the particle is moving quickly, the particle will zip through the field with only a small deflection in its path, executing only a small fraction of a turn in the process. Particles with energies higher than a GeV will not be trapped in the solar system but must come from somewhere outside.

If the energy of a cosmic ray is higher than about ten million GeV, the radius of the corkscrew caused by the galactic magnetic field is bigger than the radius of the galaxy itself. This means that cosmic rays of this energy or higher will not be trapped in the galaxy in which they originate but will leave it and travel through the depths of intergalactic space. Consequently, scientists argue that most cosmic rays that arrive at Earth with this kind of energy not only come from outside the solar system, but from outside our own galaxy. About a half dozen of these extragalactic visitors strike each square mile of Earth’s surface each year. For reference, the highest energy particles produced by human beings (at the Fermi National Accelerator Laboratory near Chicago) have energies of “only” a thousand GeV — ten thousand times smaller than extragalactic cosmic rays.

Cloud Chamber Science

What changed the study of cosmic rays from an esoteric pursuit of intrepid ballooners to a part of mainstream science was the invention, in 1909, of a device called a cloud chamber by the British scientist Charles Wilson. This is basically a cylinder with a moveable piston on the bottom. The cylinder is filled with moist air so that, when the pressure is lowered by pulling the piston down, water droplets condense out of the air. In modern language, we say that the droplets form around condensation nuclei — bits of dust in the air, for example, or the debris of disrupted atoms left behind by the passage of a cosmic ray. Thus, if a cosmic ray passes through a cloud chamber just before the piston is moved, droplets will form around the fragments of atoms it leaves behind, giving us a clear visualization of the track the particle took.

This device became the driving force behind the study of the way high-energy cosmic rays disrupt the nuclei of atoms. With the cloud chamber, scientists could see particle tracks individually, one by one. They could see what happened when the incoming cosmic rays hit a nucleus and watch the individual pieces of debris fly away from the collision. Starting in the 1930s and continuing into the 1960s (with a hiatus during World War II), one discovery after another came from cloud chambers. The first particle of antimatter to be detected by humans, for example, showed up in a cloud



Earth's magnetic field may cause a cosmic ray to orbit erratically many times depending on the particle's charge, momentum, and direction.

chamber photograph taken on Pikes Peak in 1933, and the first particle heavier than the proton was identified in 1947.

During the heyday of cosmic-ray studies, a string of mountaintop laboratories sprung up around the world. The idea was that the higher up you put the experimental apparatus, the less the energy of the cosmic rays will be degraded by collisions with atoms in the atmosphere and the deeper you would be able to delve into the mysteries of the nucleus. Some of these laboratories were pretty sumptuous, considering their isolation.

Alas, this idyllic way of doing science was not to last. By the 1960s, physicists had succeeded in building machines that could produce intense, controllable beams of particles with energies in the GeV range — enough to start creating copious supplies of particles that had previously been seen only in rare cosmic-ray collisions. In effect, physicists replaced “God’s accelerator” — whatever it is that gives cosmic rays their enormous energies — with machines that could produce high-energy particles on demand. Over the last several decades, the lonely investigators on mountaintops have been replaced by hundreds of physicists and engineers who labor around the clock at a few great accelerator laboratories. As this change progressed, the study of cosmic rays fell into decline as the physics community concentrated its attention elsewhere.

But, like the stock market after a dip, cosmic rays seem to be coming back in a big way right now. Driven by a new breed of detectors capable of spotting and analyzing the rare particles coming in with ultrahigh energies, scientists are rediscovering the exquisite mystery surrounding these visitors from deep space. Nature is still a whole lot better at accelerating particles than we are, and the highest energy cosmic rays are millions of times more energetic than the highest energies available in accelerator beams. **A**

James Trefil is an active member of Astronomy's editorial advisory board and a frequent contributor to the magazine. His most recent book is Other Worlds.

Orion® SkyQuest™ XT Dobsonian Telescopes

**Big Aperture, Superior Performance,
& Point-and-View Simplicity**

For a fraction of the cost of a little “go to” scope, you can own a telescope with serious *aperture*. See more of the universe—for less—with an award-winning SkyQuest XT metal-tube Dobsonian. It'll keep you up nights.



\$199

SkyQuest

New!

SkyQuest XT4.5

Now, young people with a curiosity for space can explore its mind-boggling wonders to their hearts' content. Because the compact SkyQuest XT4.5 is the *user-friendliest* telescope for kids to come along in years. Kids ages 8 to 88, that is, because adults won't be able to resist its portability, crisp optical performance, and point-and-view simplicity, either.

Enameled steel tube, 114mm mirror (f.l. 910mm, f/8), 1.25" R&P focuser, 6x30 finder scope, 25mm (36x) and 9mm (110x) Plössl eyepieces (1.25"), CorrectTension, built-in handle, dust cap.



\$369

SkyQuest

*SkyQuest Dobs
feature enameled
STEEL optical
tubes!*

SkyQuest XT6

The overachieving XT6 will show Jupiter's Red Spot, Saturn's Cassini Division, hundreds of clusters and nebulas, and galaxies tens of millions of light-years distant. Nicely portable and very affordable!

Enameled steel tube, 152mm parabolic mirror (f.l. 1200mm, f/8), 1.25" aluminum R&P focuser, 6x30 finder scope, 25mm (48x) and 9mm (133x) Plössl eyepieces (1.25"), Moon filter, eyepiece rack, CorrectTension, dust cap.



\$499

SkyQuest

SkyQuest XT8

The XT8's prodigious performance on both solar system and deep-sky objects have made it the telescope of choice for thousands of astronomers, from serious beginners to die-hard hobbyists.

Enameled steel tube, 200mm parabolic mirror (f.l. 1200mm, f/6), 1.25" aluminum R&P focuser, 6x30 finder scope, 25mm (48x) and 9mm (133x) Plössl eyepieces (1.25"), Moon filter, eyepiece rack, CorrectTension, dust cap.



New!

\$649

SkyQuest XT10

Aperture rules. So meet the new telescope King. Its 250mm-diameter parabolic mirror gulps in over 50% more light than an 8" scope, to reach farther into deep space. The sheer number of objects visible in the XT10 is staggering, and its prodigious resolving power reveals intricate structure in nebulae and galaxies that's invisible in smaller scopes.

Enamelled steel tube, 250mm parabolic mirror (f.l. 1255mm, f/5), 2" aluminum R&P focuser, big 8x50 finder scope, 25mm (50x) and 9mm (139x) Plössl eyepieces (1.25"), Moon filter, eyepiece rack, Correctension, dust cap.

ORION
TELESCOPES & BINOCULARS

Our
25th
Year!

Everything for the Amateur Astronomer—Delivered Direct

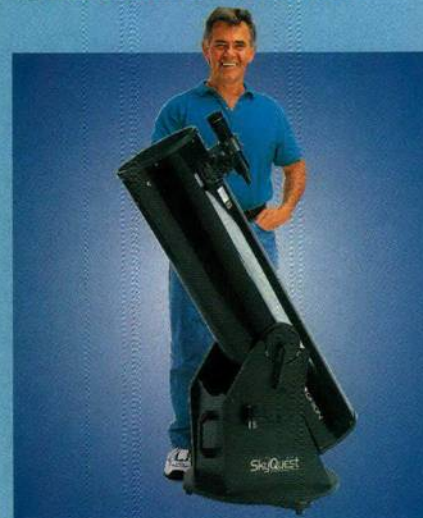
FREE 100-PAGE CATALOG Call toll-free (800) 447-1001

Selected Orion products are also available at authorized astronomical dealers.

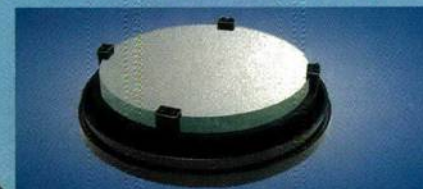
Shipping/handling is additional. Dealer prices may vary.

telescope.com

The XT10 - A Big Dob With Better Features



The XT10 and all other XT models feature a professional-quality, enamelled steel optical tube, not cardboard as on cut-rate Dobs.



The XT10's diffraction-limited 250mm parabolic primary mirror collects over 50% more light than an 8" mirror, to reach farther into deep space!



The XT10, like all SkyQuest Dobs, comes standard with two fully coated Plössl eyepieces (1.25"): 25mm (50x) and 9mm (139x).



A 2" aluminum rack-and-pinion focuser is standard on the XT10, along with an adapter for 1.25" eyepieces. The XT10 also boasts a big 8x50 achromatic finder scope. All other XT models come with a 1.25" focuser and 6x30 achromatic finder.



All SkyQuest telescopes have large 5" flanged altitude hubs and Orion's exclusive Correctension Friction Optimization, for superior balance and motion control.

M. Lorenzi/C. Favrelio



SHOWERED IN MYSTERY

*An international team
of astronomers is looking for the source of enigmatic
high-energy cosmic rays.*

by Ivan Semeniuk

A bizarre crop of pale-yellow cylindrical tanks is sprouting from the dry pampa about 600 miles west of Buenos Aires, Argentina. Each tank, sporting a solar panel and communications antenna, looks like an alien spaceship that has landed precisely in the middle of nowhere. In reality, the squat containers are the first of an array of 1,600 detectors that will look for cosmic rays in an area of sky the size of Rhode Island. The region's lack of rain won't hurt these high-tech transplants. They will record showers triggered when subatomic particles with the kinetic energy of a 120-mile-per-hour fastball — ultrahigh-energy cosmic rays from deep space — hit Earth's upper atmosphere. These collisions, about 6 to 12 miles (10 to 20 km) in altitude, trigger invisible avalanches of secondary particles lasting only a few microseconds that reach maximum intensity just above Earth's surface with as many as 100 billion particles traveling at nearly the speed of light.

Welcome to the Pierre Auger (oh-ZHAY) Observatory. It is aimed squarely at one of science's most intriguing puzzles: identifying the source of the highest energy cosmic rays, which originate mysteriously thousands or millions of light-years from Earth. More than 250 scientists from 19 nations, including the United States, have helped plan the construction of the \$50-million

Galaxy collisions set off firestorms of cosmic-ray emissions. Brad Whitmore (STScI), NASA

MYSTERIOUS COSMIC RAYS

Energy ↑

10^{21} eV

↑
?

The sources of these cosmic rays are unknown

10^{18} eV

Active galactic nuclei/black holes

10^{15} eV

Pulsars/neutron stars

Supernovae

Likely limit of human technology

10^{12} eV

Fermilab particle accelerator

10^9 eV

10^6 eV

Nuclear reactors

10^3 eV

Television picture tube

1 eV

Flashlight battery

"Once you've learned about this problem it just demands that you do something about it," says James Cronin, a Nobel Prize-winning physicist at the University of Chicago who coheads the Pierre Auger project with Alan Watson, a physicist at the University of Leeds in England. "It's a classic scientific mystery."

"That's macroscopic energy inside a microscopic particle," says Pierre Sokolsky, a cosmic-ray expert at the University of Utah. "It's hard to conceive of how that's happening. We're trying to understand the extremes of energy creation." These cosmic rays are so highly energetic that the Milky Way Galaxy's magnetic field barely affects their paths, a lucky break that will enable Cronin, Watson, and their colleagues to use their field of detectors in Argentina as an actual observatory.

Because the highest energy cosmic rays are so rare, a detector the size of Manhattan would only be expected to see one per year. To capture as many as 60 a year, the team hopes to build arrays in Mendoza Province, Argentina, and Millard County, Utah, each with 1,600 detectors covering about 1,170 square miles (3,000 sq km).

Since March 2000, engineers have been busy installing the detectors about a mile from one another in a remote area near the towns of Melargue and San Rafael. Each detector contains 3,000 gallons of highly purified water. Primary cosmic-ray particles are destroyed during their passage through Earth's atmosphere, producing an avalanche of secondary particles. These secondary cosmic rays pass through the water while exceeding the standard speed of light in water and reveal their presence with a faint blue light called Cerenkov radiation. Each detector also has a Global Positioning System receiver that will enable the observatory to measure timing of a shower to within 50 nanoseconds and timing between individual detectors to within 10 nanoseconds. The precision will allow scientists to pinpoint the incoming direction of the shower and triggering particle to within one degree.

Like spacecraft, the detectors are built to operate automatically. Each unit relies on the sun for power and cell-phone technology to transmit data. The objective of the experiment

Cosmic rays come in all energies — equivalent to particles produced by household appliances all the way up to ultrahigh-energy particles that the Pierre Auger Observatory will detect.

is to measure the arrival direction, energy, and mass composition of cosmic-ray air showers above 10^{19} electron volts (eV). (In the language of particle physics, elementary particles are referred to in terms of their energies in eV, with 1 eV being the energy acquired by an electron falling through a potential difference of 1 volt. Particles in a television picture tube carry about 10^3 eV each.)

Initial observations in Argentina will begin in 2001, and the entire Argentine array is scheduled for completion by 2004. (A construction schedule for the array in Utah has not been set.) In combination, the Southern and Northern Hemisphere arrays will offer the best chance of pinpointing where the highest energy cosmic-ray particles come from and whether the locations correspond to known astronomical objects. "The rotation of Earth produces a uniform scan of the whole sky," says Fermilab physicist and Auger Observatory project manager Paul Mantsch. If the ultrahigh-energy cosmic rays originate from all directions, theorists will have some explaining to do. Indeed, a new branch of exotic physics may be required to explain how such particles are created.

"I think it's really exciting that we have no obvious answers," says Angela Olinto, a theoretical astrophysicist at the University of Chicago. "It means there is likely to be something surprising at the other end."

Shower Power

Of course, very few cosmic-ray particles are as incredibly powerful as those the observatory is looking for. Every second, an invisible barrage of lower energy particles passes through your body on its way to plowing into Earth. These are secondary particles, including a significant number of muons — elementary particles with the same charge and spin as an electron but with 207 times more mass. Muons have a lifetime of 2.2 microseconds before they decay into electrons and neutrinos, but because they are not affected by nuclear forces they pass unhindered into Earth's crust through the atmosphere and human bodies.

Muons are vitally important. They are so short-lived they can't possibly be coming from deep space: They must be produced when primary cosmic-ray particles strike Earth's atmosphere.

Cronin recounts his favorite cosmic-ray demonstration to audiences: "Take a pair of Geiger counters and set them up at either side of the room," he says. Both Geiger counters, which are efficient detectors of ionizing particles such as muons, will pick them up at random. But every now and then something triggers the two counters at precisely the same instant, like a pair of speakers attached to one stereo.

It was French physicist Pierre Auger who first performed this simple experiment, and it's the reason the new observatory was named in his honor. In 1938 Auger detected simultaneous muons from cosmic rays when he placed his counters several hundred feet apart. He realized the particles arriving concurrently must be part of the same event.

Auger was able to go one step further. By estimating the total number of secondary particles in a shower, he could calculate the energy of the primary particle that caused it. The results were surprising. Some cosmic rays were registering in excess of 10^{15} electron volts (eV) — far more energy per particle than anyone had ever seen before.

Since Auger's time, physicists have used this method to detect showers and identify primary particles over a broad range of energies. This data can be turned into a cosmic-ray

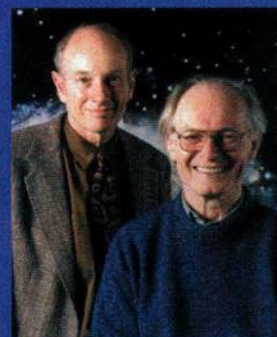
PIERRE AUGER OBSERVATORY



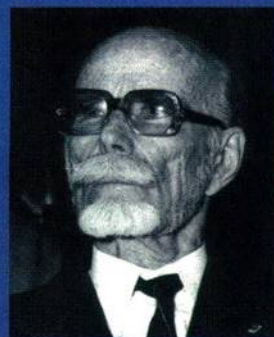
The southern section of the observatory will be built on this plain in Mendoza Province, Argentina. Pierre Auger Observatory



The detectors of the observatory, like this prototype, are designed for low maintenance. Pierre Auger Observatory



James Cronin, left, and Alan Watson, right, lead the project. Pierre Auger Observatory



French physicist Pierre Auger discovered cosmic-ray air showers. CERN

spectrum, showing the relationships between cosmic-ray particles of various energies and their rates of occurrence. The higher the energy, the more infrequent the particle. To find out how high the spectrum might climb, researchers needed progressively larger detectors to observe the rarest events.

It was this strategy that led MIT physicist John Linsley to create the first large-scale detector array in 1960. Located at Volcano Ranch, New Mexico, the array consisted of 19 detectors spread over 3 square miles. With this net, Linsley routinely reeled in cosmic ray showers with energies above 10^{17} eV and even 10^{18} eV. But the most important single detection came on March 19, 1961, when the array observed a shower packing more than 10^{20} eV. It was the first direct evidence for ultrahigh-energy cosmic rays.

In a Fly's Eye

For 30 years, scientists had good reason to doubt the Volcano Ranch result. Astrophysicists suspected that most primary cosmic rays are ordinary protons. When a large star goes supernova, it thrusts a powerful shock front into the surrounding environment, tangling its local galaxy's magnetic field. Any charged particle, such as a proton, receives a powerful kick as it crosses the shock front and may do so again and again as it follows the twists and turns of a distorted magnetic field. These repeated kicks can accelerate protons up to 10^{15} eV — about one trillion times the energy of protons in the solar wind. Supernova shock fronts also accelerate the nuclei of heavier atoms such as carbon, oxygen, and iron, which account for at least some of the cosmic rays with energies up to about 10^{18} eV. But not even a supernova has the force needed to boost a particle to 10^{20} eV.

Such particles, it turns out, face a ruthless energy limit imposed by the cosmic microwave background. Discovered in 1965, this remnant radiation from the Big Bang permeates the universe with its cool, invisible glow. The background

radiation has no significant effect on those of us who travel at pedestrian speeds. But to cosmic-ray particles tearing through space at nearly the speed of light, the low-energy-microwave photons of the cosmic background behave like energy-draining molasses. Regardless of how much energy a particle starts with, by the time it has traveled roughly 100 million light-years the microwave background will have reduced it to somewhat less than 5×10^{19} eV. While this doesn't completely rule out a 10^{20} eV cosmic ray, it means that such a source must be nearer than 100 million light-years — relatively close by cosmic standards.

Confirming the 5×10^{19} eV cutoff became the goal of "Fly's Eye," a different kind of cosmic-ray observatory that opened for business in the Utah desert in 1978. Sokolsky explains that this kind of experiment takes advantage of the dim ultraviolet light produced when cosmic-ray showers pass through the atmosphere. The Utah observatory used a series of ultraviolet detectors that partitioned the night sky into 67 segments — an insect's view of the universe. These detectors trace the meteorlike descent of air showers, measuring the energy and direction of the primary cosmic-ray particle as well as information about its mass.

The advantage of an instrument such as the Fly's Eye is that it can see showers about 18 miles away in any direction and is equivalent to a detector array covering about 250 square miles. However, the Fly's Eye works only on dark, clear, moonless nights — roughly 10 percent of the time. It was on one of those nights — October 15, 1991 — that Fly's Eye picked up a cosmic-ray shower that was off the scale. Unfortunately, researchers plotted their data at the time on a graph that stopped at 10^{20} eV.

Shock waves generated during the self-destruction of a massive star, such as Supernova 1987A, can boost the energies of cosmic rays up to about 10^{14} to 10^{15} electron volts. Hubble Heritage Team (AURA, STScI, NASA)



"We sat on this for almost two years," recalls Sokolsky. "We understood it was an extremely interesting result and we wanted to be sure it wasn't an instrumentation problem." The sensational result, published in 1993, indicated a cosmic-ray particle with 3.2×10^{20} eV. The finding was bolstered by two more detections by the Akeno Giant Air Shower Array (AGASA) in Japan, including a detection of a 2.0×10^{20} eV cosmic ray on December 3, 1993. The news was out. There were cosmic rays with energies well above the theoretical cutoff, and they were in serious demand of an explanation. The Auger Observatory will look for particles so rare and energetic that they come along once in a lifetime.

To find them, says Mantsch, the Auger Observatory will have several sky-fluorescence detector stations at the Argentina and Utah arrays. Each such detector station will contain 48 reflector-telescope units, each with a 4-meter mirror that focuses light from the sky on 100 light-detecting photomultiplier tubes.

Unusual Suspects

Astrophysicists trying to understand the nature of ultra-high-energy cosmic rays must grapple with many questions, including the nature of the incoming particles themselves. Although there is no direct way to identify primary cosmic-ray particles at these energies, different types of particles will tend to penetrate the atmosphere to different depths before initiating air showers. So far, the few events that have been seen with energies greater than the theoretical cutoff suggest the primary particles are protons. But given that very few particles have been seen at the highest energies, the statistics are far from definitive.

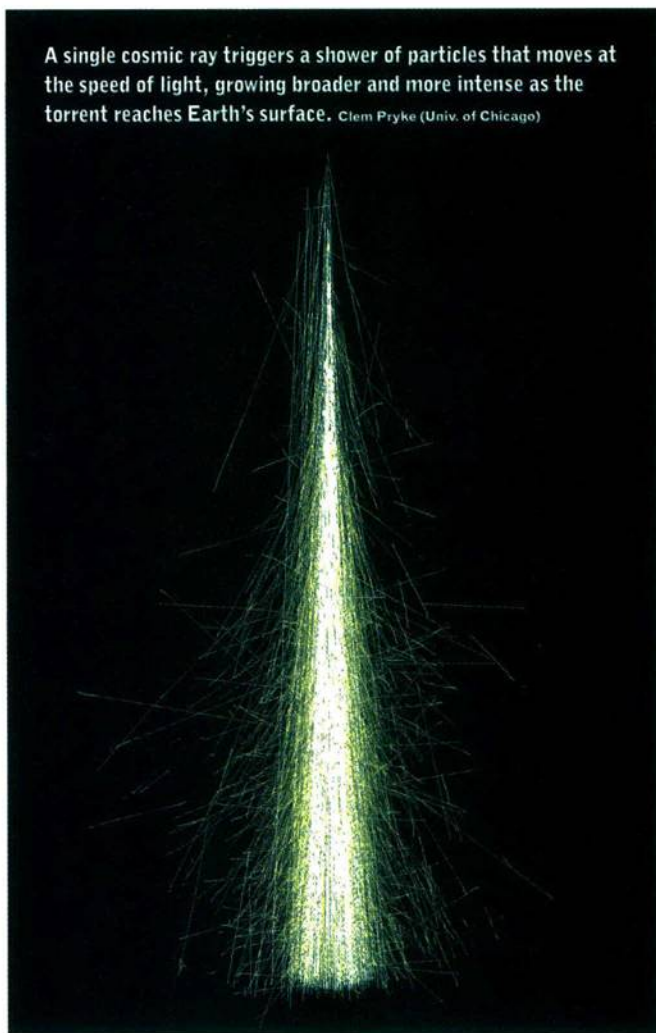
"A proton could look like an iron nucleus or maybe even a photon," cautions Olinto. "Right now the data is consistent with protons, but we need more data."

A much tougher nut to crack is the question of where the particles are coming from. Like bullets, the highest energy cosmic rays should point directly back to the cosmic guns that fire them. But so far there are no obvious associations between the directions of the incoming particles and any known galaxy, cluster of galaxies, or other astronomical object. Until an obvious source is found, theorists can only speculate about what sort of violent process spits out, as Sokolsky says, "individual particles with the energy of a lead brick that you drop on your toe."

When it comes to hot, violent processes, astrophysicists usually corner the market. After all, when you've got the observable universe to choose from, many suspicious characters turn up. However, in this case the options are limited because the sources of the highest energy cosmic rays must lie within 100 million light-years of Earth. That rules out quasars, gamma-ray bursters, and other highly energetic objects.

One scenario that has not been ruled out involves the spectacular jets that issue from the centers of some active galaxies, where giant black holes are devouring gas and stars. As these jets slam into the intergalactic medium they produce shock waves, similar to those of supernovae, but of greater force. "These are pretty reasonable places for acceleration," says Olinto. And they have the added benefit that accelerated particles can escape before losing their momentum. But if jets are the answer there is another problem. The only such jet within 100 million light-years of Earth belongs to the galaxy M87; however, none of the highest energy cosmic rays detected so far seem to be coming from M87's direction in the constellation Virgo.

A single cosmic ray triggers a shower of particles that moves at the speed of light, growing broader and more intense as the torrent reaches Earth's surface. Clem Pryke (Univ. of Chicago)



Can something divert a high-energy cosmic-ray particle from its beeline flight, concealing its point of origin? Lower-energy cosmic rays appear to come from all directions because their paths are twisted by the Milky Way Galaxy's magnetic field. However, particles greater than 10^{18} eV are too energetic to be affected in this way. On the other hand, some theorists suspect that unexpectedly strong magnetic fields outside the galaxy may be bending the paths of those particles.

If astrophysicists can't account for the highest energy cosmic rays with conventional sources, less conventional options are standing by. They include strange relics of the Big Bang, which, in theory, could decay into high-energy cosmic rays. Possible candidates include a variety of exotic superheavy particles that may be lurking in the dark matter surrounding our galaxy. Space itself could be the culprit: it could be riddled with dimples called "topological defects" that unravel with a flash of cosmic rays.

Such extreme explanations raise the stakes on the cosmic-ray problem. Depending on what the Auger Observatory and other experiments find, cosmic-ray researchers may uncover a very different universe from the one we thought we were living in. Whatever the outcome, Cronin says, "I don't think the answer will be mundane." **A**

Ivan Semeniuk, a science writer and producer for Discovery Canada, lives in Toronto.

Military Magic Boosts Astronomy

Declassified technology enhances celestial knowledge.

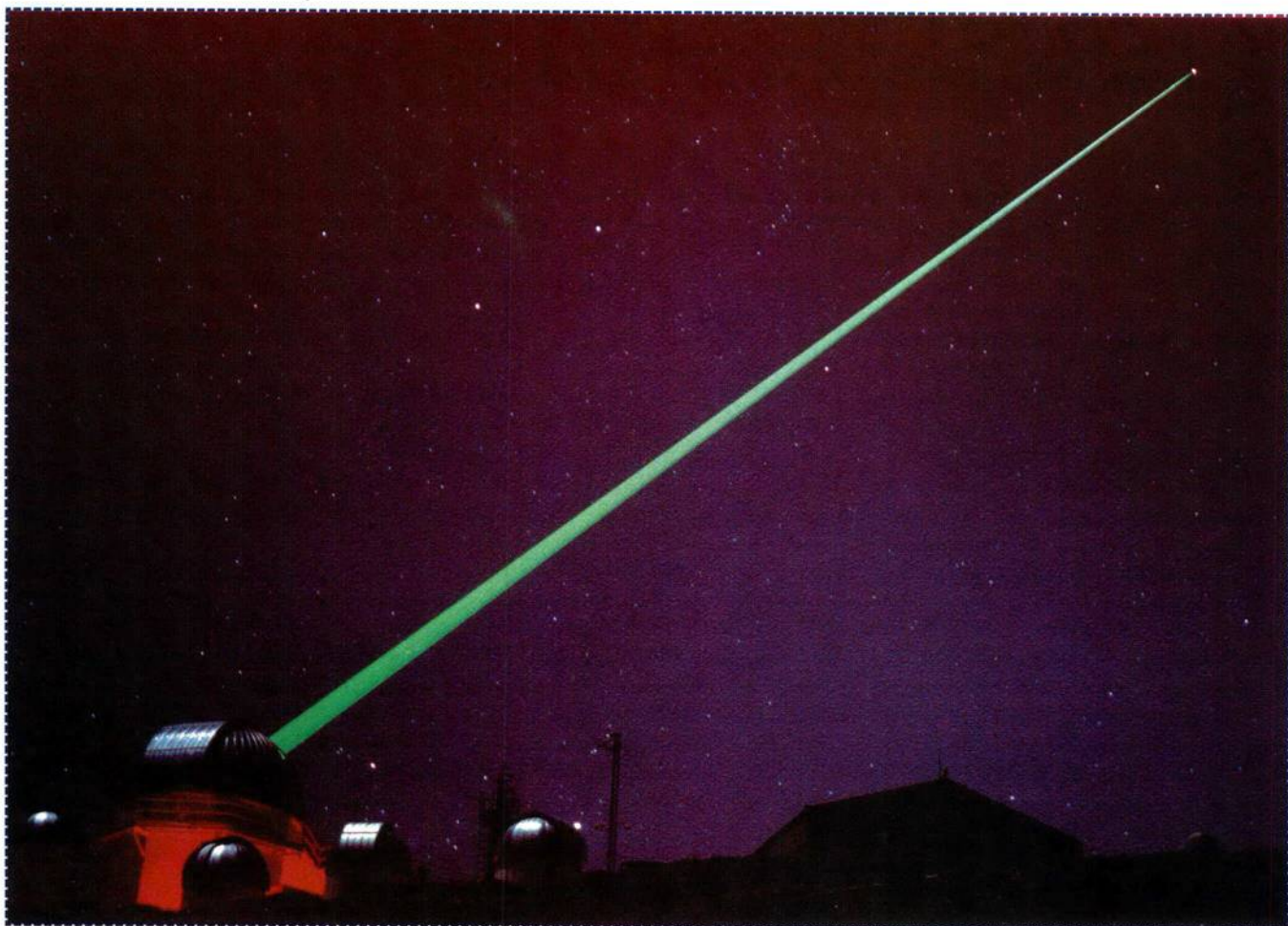
by James Oberg

The timeless precept about beating swords into plowshares still rings true. Military innovations have filtered down to civilian astronomy and helped expand our knowledge of the universe. We're fast approaching an astronomical renaissance of unprecedented degree where weapons-related technology turns askew to benefit science. Nailing down the exact details of how original military projects evolved takes some detective work, but the resulting story is an exciting complement to a technology once focused solely on destruction.

The list of examples astounds: Precisely ground mirrors built for antiaircraft searchlights and later used in spy satellites instead reflect starlight in telescopes. Radar receivers built to track enemy planes in World War II map the radio universe. Automated telescopes that followed Cold-War satellites in the 1970s now search for comets and near-Earth asteroids. Britain's massive 76-meter Jodrell Bank Observatory, built in 1957, employs gimbaled radio antennae that mimic turret bearings developed for battleships. Deep-space detectors watching for secret nuclear tests first spotted and identified gamma-ray bursters — thus helping to solve one of the mysteries of modern astrophysics.

Liftoff: An Atlas Centaur rocket sends a payload into space on December 19, 1971. Developed in the late 1950s to launch U.S. ICBMs, Atlas rockets underwent several transformations over the decades. John Glenn rode a modified Atlas ICBM into orbit in 1962. Subsequent Atlas launches dispatched probes to Mars, Venus, Mercury, and Jupiter. Eventually, the Atlas-Centaur combination evolved into the Atlas 2A version used by General Dynamics to launch communication satellites. NASA





An example of a dramatic conversion of weapons technology into astronomical tools occurred in 1946 when captured German V2 missiles — which rained death on London two years earlier — were fired from White Sands, New Mexico, carrying scientific instruments. Experimental payloads measured micrometeoroid density, background sky brightness, and cosmic, solar, and x-ray radiation. About a decade later, Russia's Proton and R7 rockets, as well as America's Thor, Atlas, and Titan systems (all originally funded to carry thermonuclear bombs) opened the space frontier.

One of the best aspects of this technological flow is that it doesn't stop with professional astronomical programs. Image-intensifiers, and later Charge Coupled Devices (CCDs), developed for military applications in the 1960s, entered astronomy the following decade, soon reaching amateurs as well as professionals. The increase in low-light sensitivity revolutionized astronomical imaging, replacing photographic film in many applications. Small, battery-powered image intensi-

fiers now allow for longer exposures with better results in both research and amateur astrophotography.

GPS Aids Astronomers

Paul Maley, an amateur astronomer who works at NASA's Johnson Space Center and chases short-lived celestial phenomena as a hobby, rarely thinks of the military origins of many of his observational tools. Without them, however, some of Maley's observing projects would prove impossible. For instance, hand-held global positioning system (GPS) receivers let Maley and other observers take what was developed as a military navigational device and apply it to solar astronomy — a totally unexpected but serendipitous application. "You need to know your location on Earth to better than 10 meters," Maley says. "There is no substitute for the GPS."

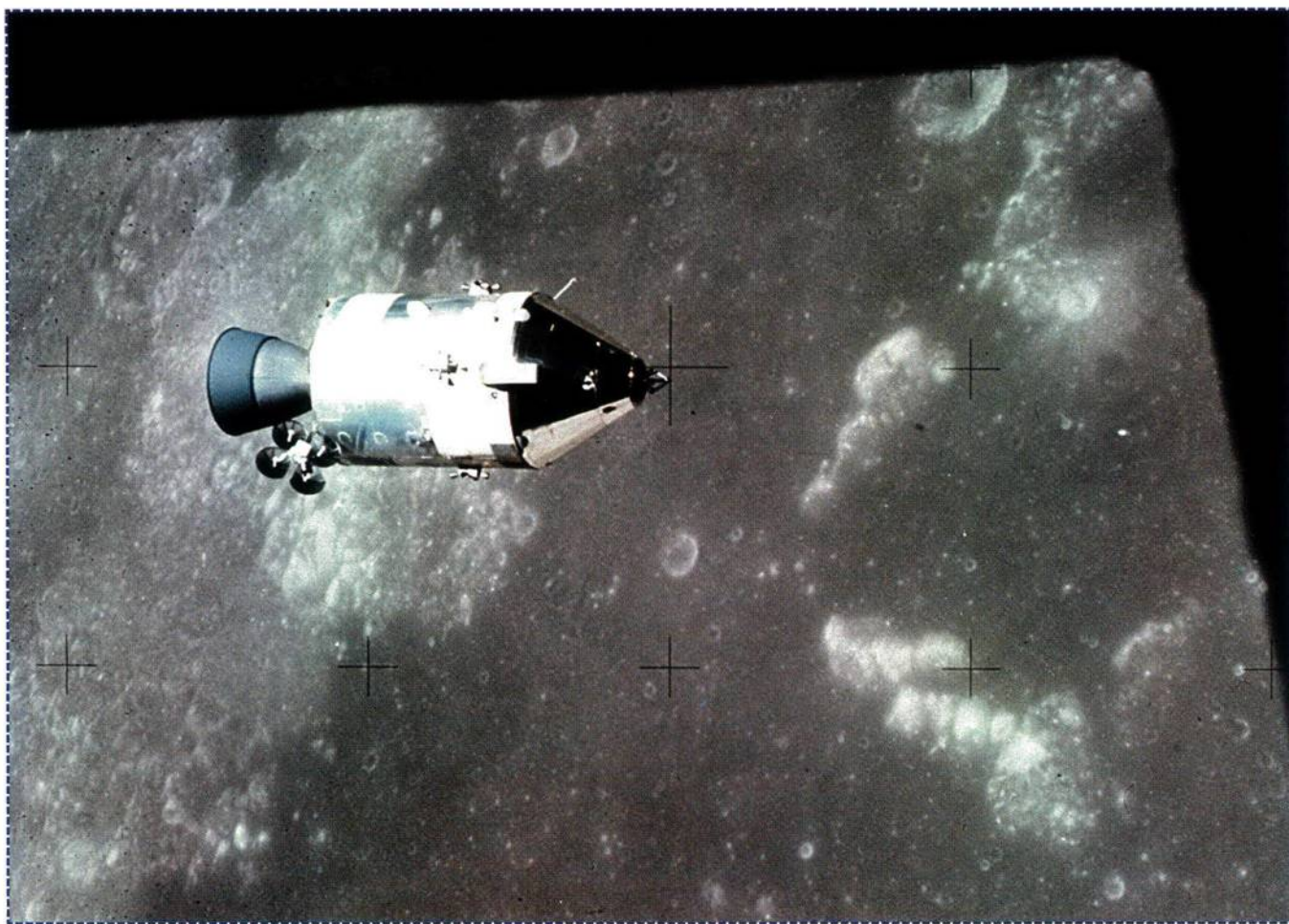
Amateur astronomers often use GPS technology during eclipses to measure the profile of the lunar polar regions by watching stars graze past the limb. This information allows observation of the very edge of solar eclipses in order to

A laser guide star allows astronomers to compensate for atmospheric turbulence in order to improve "seeing." AFRL/DE

precisely measure the sun's radius as the altitude of its photosphere — the glowing surface — rises and falls.

"The biggest error, aside from the heights of the features on the moon, was always the location of the observation sites," Maley explains. Most GPS systems provide a tenfold increase in accuracy when compared to the best survey maps available, he says. And because the lunar profile is mapped to within 10 meters, ground-site locations must meet that accuracy level.

Current and former observations benefit from GPS, Maley says. He is resurveying older eclipse observation sites, such as the famous July 29, 1878, site of totality at Pikes Peak, Colorado. (Future Smithsonian Institution director Samuel P. Langley was at Pikes Pike while inventor Thomas Alva Edison watched the eclipse from Rawlins, Wyoming. Each man unsuccessfully tested an instrument to measure the corona that day.)



Above: The Apollo 15 astronauts snapped pictures using a top secret spy-satellite camera — but only during lunar orbit. NASA/JPL

Right: Britain's 76-meter radio dish at Jodrell Bank — a small portion of which is visible here — employs several elements modified from military use, such as turret bearings and battleship gun elevation mounts. Ian Morison



Now that civilian GPS (with resolution improved from several hundred to several meters) is available, Maley expects to determine long-term variations in the solar diameter.

And while GPS is coming into common use, another military-to-civilian adaptation that revolutionized astronomy in the 1990s is the development of adaptive optics (AO). AO eliminates the detrimental effects of “seeing” through a randomly refractive atmosphere. No longer limited by the optical size of the telescope, AO technology enhances observing.

Telescopes equipped with AO provide views unaffected by the gaseous soup through which they peer. Before the development of AO, point sources

were smeared into flickering, wavering blobs. Astronomers use AO technology to not only measure the flickering of starlight, but also to cancel out that distortion by activating tiny motors behind thin telescope mirrors that twist

the mirror surfaces to redirect the light and produce a more useful image.

While the theory of adaptive optics sprang from imaginative astronomers back in the 1950s, the hardware (and the equally crucial software) was built

Untwinkling Twinkling Stars

Adaptive optics technology compensates for atmospheric turbulence while observing from Earth's surface. Weapons engineers developed adaptive optics (AO) to spot targets such as incoming warheads or enemy satellites. Targets tracked accurately through atmospheric disturbances using AO technology could be blinded, disabled, or destroyed with a concentrated burst of light. Originally funded in the 1980s through the Strategic Defense Initiative (SDI) program, AO development was known as "Star Wars Technology."

"During the Cold War, AO was extremely classified," explains Paul LeVan, a scientist at Kirtland AFB in New Mexico. "About 1991, a lot of astronomers were making proposals to try it, and this was noticed in the Defense Department." By then, the military systems were already much more advanced than the civilian systems. "We normally had 250 to 500 actuators on the mirrors, compared to only a handful of actuators on civilian experiments," LeVan explains.

The collapse of the Soviet Union — and with it a change in strategy in the "Star Wars" program — meant that the U.S. no longer needed AO technology as protection. In 1992, the Air Force hosted a conference in Albuquerque, New Mexico, describing AO to the public.

"A wavefront sensor generates the correction within a reaction time of 10 milliseconds," says LeVan. As a result, the military AO systems compete with the theoretical resolution of the Hubble Space Telescope — at least over a limited angle of about 10 arcseconds. "And it doesn't have to be close to the vertical," he adds.

Adaptive optics works by untwinkling starlight. The key lies in measuring the amount of twinkle caused by atmospheric turbulence and then untwisting that light by slight bends in special mirrors. But measuring those distortions is challenging because they are highly localized and change very quickly.

One technique is to focus on a bright, nearby star with a known distance from Earth and measure the amount of distortion its light suffers and then compare that distortion rate to the target of interest. However, if the known star is too distant from the target of interest to use as a distortion control, it cannot serve as an accurate model of the turbulence through which the target star's wavelength travels.

To solve this limitation, the Air Force developed technology to produce laser guide stars — also called "artificial stars." High-powered laser beams illuminate a section of the atmosphere 12 to 15 miles (20 to 25 km) above Earth's surface. As this "twinkling" light bounces back, distortions are measured and compared to the target distortions. (See photo, page 50.)

In more highly classified research, the Air Force used a special laser to excite a small area (no larger than a meter in diameter) in the atmosphere's "sodium layer" at altitudes of 50

to 56 miles (80 to 90 km). Although this technique used a laser of comparable energy to the first experiments, it produced an artificial guide star 10,000 times brighter — even though it was much higher. Light from this higher "star" was measurable day and night and allowed for measurement and compensation of almost the entire turbulent atmospheric path.

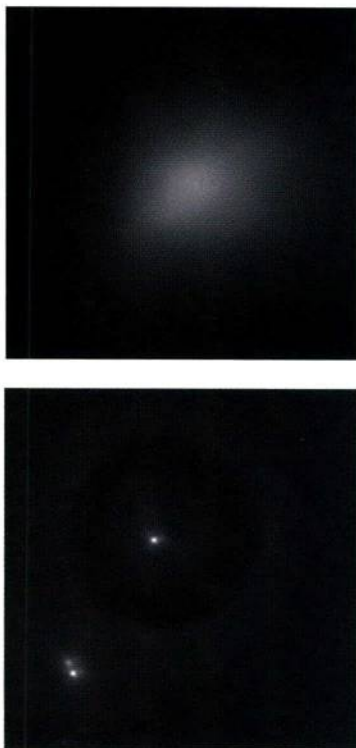
Amateur astronomers noticed and photographed these "artificial stars" over San Francisco Bay during secret military testing programs at Lawrence Livermore National Laboratory. These naked-eye "UFOs" were only explained years later.

Lasers of such power weren't just lying around warehouses and were prohibitively expensive for astronomers to develop from scratch. But government research had already built these devices for other purposes. For example, one laser used for AO research at Lawrence Livermore was originally funded by the Department of Energy for separating uranium isotopes at a commercial nuclear power plant.

By the late 1980s, these experiments were measuring starlight intensity at about

40 percent of the theoretical maximum, compared to between one and five percent for conventional telescopes. In contrast, the Hubble Space Telescope achieves between 60 and 85 percent, according to Robert Fugate, range director of the Starfire optical facility near Albuquerque, New Mexico.

While astronomers consider a resolution of about five microradians "good seeing," the military AO telescopes regularly produced images with about one-third of a microradian or better resolution. Thanks to AO, researchers use the increased resolution to look deeper into space and explain the mysteries of the universe. And, from all indications, military scientists are as delighted with the technology transfer as are astronomers.



Images of triple star 52 Herculis taken without (top) and with (bottom) the aid of AO.

J. Chris Shelton and Nils Turner (Mount Wilson Institute) and Christ Ftaclas (Michigan Technological University and National Science Foundation).

from the military budget three decades later. Observing celestial beauty wasn't exactly the Pentagon's main goal, so for a long time, these capabilities were classified as top secret and withheld from astronomers and researchers who could use AO for different purposes.

Nearly Perfect Seeing

"Two of the adaptive optics systems with which I'm involved have military components or origins," says Sallie Balunas of the Mount Wilson Observatory near Los Angeles. "The first was mounted at the 60-inch telescope and produced diffraction-limited images in the visible," she says. "That was an already developed but decommissioned military system. Our goal was to see if it could be retrofitted for astronomical research to a telescope built in 1908."

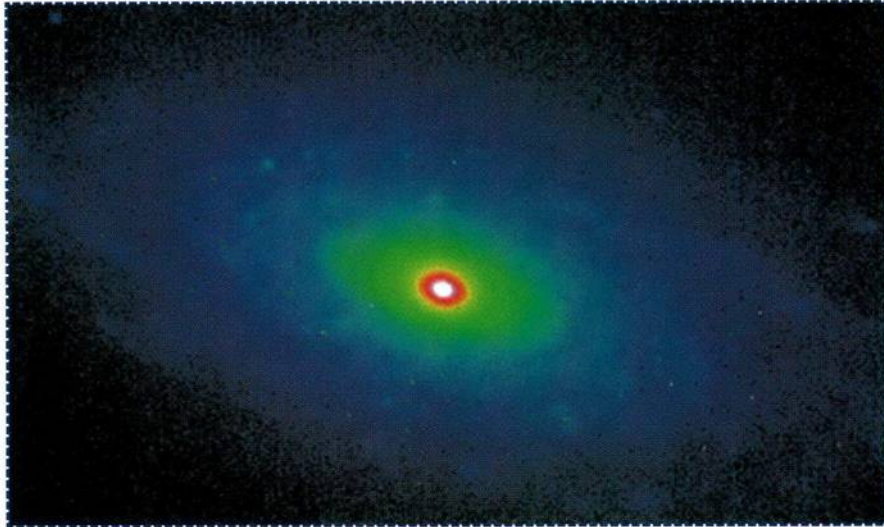
It worked, so they tried another approach with an AO mirror on loan from the U.S. Air Force. In use since 1994 at the 100-inch Hooker Telescope at Mount Wilson, this AO mirror achieves nearly perfect seeing in the visible part of the spectrum.

Like vestigial organs, astronomical equipment that evolved from military gear often retains traces of its origins. University of Alabama astronomer Bill Keel explains how the precise source of the military-derived sensors could sometimes be determined: "One of our support astronomers at Kitt Peak enjoyed pointing out how to tell, from detector characteristics like wavelength range and timing, which systems started life in strategic or tactical use," says Keel.

Manipulation of atmospheric turbulence corresponds to the portion of electromagnetic spectrum being observed. Air turbulence varies on the scale of arcseconds, so two target points more than a few arcseconds apart on a visual image require separate compensation. Scientists have found that infrared untwinkles easier than visible wavelength light.

The military used infrared to see in the dark, track enemy missile plumes, or follow "cold" warheads moving through space. Consequently, infrared technology was part of a highly classified, generously funded, and aggressive research program. Astronomers, on the other hand, were interested in detecting and using infrared radiation at a more intellectual level for research purposes.

These efforts paid off. Last February, the Rockwell Science Center in



Thousand Oaks, California, proudly announced the unveiling of "the world's largest astronomical infrared sensor." In a program funded by the University of Hawaii, the infrared sensor now searches deep space in order to detect very faint galaxies. This mercury-cadmium-telluride sensor measures infrared radiation with wavelengths between 0.9 and 2.5 microns. It uses a complementary metal oxide semiconductor (CMOS) technology that converts incoming observations into a usable digital signal.

"Faulty" Arrays Reused

Kadri Vural of the Rockwell Science Center explains that the technology was funded primarily by the military. "They used those kinds of detectors for missile seekers and surveillance systems," he says. Initial arrays were about 16x16 or even 32x32 pixels. They were barely good enough to detect and discriminate missile plumes from reflected sunlight. The current instrument is 4cm square with an array of 2,048 pixels on each side.

Other applications attempted to exploit the reflected sunlight, Vural recalls. "When I came to work here in 1980, we had a contract with the Jet Propulsion Laboratory to make devices for remote sensing," he says. Different reflections off rocks, dirt, plants, and water allowed scientists to chart Earth's surface. Manufacturing flaws in some of the 64x64 arrays failed acceptance testing because they contained large areas of inoperative pixels.

Stacks of those faulty arrays were sent to astronomers at the University of Arizona in the mid-1980s, according to Vural. "We built these devices to

An enormous bulge backlights dust in the outer disk of spiral galaxy NGC 3521. This near-infrared 2.2-micron-band image is possible thanks to technology declassified by the military about 15 years ago. Before that, astronomers scanned back and forth across galaxies in time-consuming searches. What now takes only minutes to image once took a week or longer. Bill Keel, University of Alabama

observe Earth," he says, "but the astronomers wanted to enhance sensitivity. So they built their own cooling system and bled liquid nitrogen past the sensors." Cooling sensors don't always improve sensitivity, but in this case, Vural says, it did.

"Infrared astronomers say we've revolutionized astronomy," Vural notes with satisfaction.

And while many of the latest scientific gadgets appear to come straight from a *Buck Rogers* scenario, not all the innovations used by astronomers today were spawned by high-tech military developments of the last half century: Consider hot air balloons, for example. Used by the military in the Civil War as lookout stations, recent balloon advancements may soon place these simple devices at the cutting edge of space exploration. A full-scale Ultra Long Duration Balloon (ULDB) mission is planned for December 2001 to study the use of balloon platforms in near-space missions.

Seems we're still beating on swords after all. **A**

James Oberg worked at NASA's Mission Control for 22 years. He is now a full-time writer, consultant, and speaker. Visit his home page at <http://www.jamesoberg.com>.

Anyone can sell you a telescope.



Meade ETX-90EC
\$595
Meade ETX-125EC
\$895
#497 Autostar
\$149



Hardly a day goes by that we don't get a note or E-mail message like the one reprinted on the next page, or a call that goes something like this: "Your ads are right. Dealer so and so advertises low prices – but they don't have what I want in stock, they couldn't answer any of my questions, and they wanted my credit card number before they'd even talk to me. They said if I wanted to ask questions, I should call the manufacturer... and then they hung up on me!"

If you want the right telescope, you need more than a camera store clerk armed with only a price list and not a clue in the world about astronomy.

What you *really* need are people who will take the time to listen to what *you* need, people who can answer your questions, people with years of experience

using and selling telescopes who can help you get the most telescope for your dollar. That's exactly the kind of people you'll find at **astronomics**.

Unlike camera stores and shopping mall gift shops, telescopes are our specialty at **astronomics**, not just a sideline. We're a family-owned full-line telescope dealer – not just a few toy telescopes stuck off in the corner of some no-help department store, toy store, or gift shop as an afterthought. And, unlike department store clerks, we don't work on commission, so we won't try to sell you more than you need just to pad our paychecks.

We've been helping people choose the right telescope since 1979. We have the experience to help you pick the scope that fits your needs... and your budget... from the many Meade, Celestron, TeleVue, Takahashi, and Questar telescopes we keep in stock at discount prices from \$99 to \$27,995.

And we can usually ship your right telescope right away. We had 1162 scopes in stock as we wrote this on 10/5, and an additional 1000+ on order! **astronomics**. No hard sell. No guesswork. Just honest advice, the *right* scope, and a good price. Call us at (405) 364-0858 and find out for yourself.

We buy telescopes by the ton... literally!

The day before this copy was written, we received 305 cartons from Meade – 3¼ tons of scopes and accessories in one shipment. Earlier in the same week, we received 9791 pounds of Celestron scopes and accessories in a single shipment – 21 pallets, a full trailer load. We don't know of many dealers – if any – who regularly stock Celestron and Meade products in those quantities... *no matter what they claim*. But we do. Telescopes, eyepieces, filters, CCD cameras and autoguiders, dew caps, Barlows, off-axis guiders, illuminated reticle eyepieces, electric focusers, T-adapters, tele-extenders, counterweights – we keep them all in stock.

Buying in such large quantities allows us to take advantage of special buys – extra savings that we pass on to you.

A new low price on the Celestron NexStar 8... and we ship for free!

Here's a deal that doesn't come along very often – a \$200 price cut and free shipping within the continental United States on a go-to scope that got a rave review in the November *Sky & Telescope*! The sleek Celestron NexStar 8 is powered by AA batteries, so it's portable indeed. It has 8" f/10 Starbright multicoated optics, a go-to computer with an 18,000+ object database, a long eye relief Star Pointer non-magnifying finder, a 40mm NexStar Plössl eyepiece, an AC adapter, a tripod, and more.

Free shipping, a \$200 savings, and best of all... it's in stock!



Celestron NexStar 8
\$1699



Meade 8" LX90
\$1695

The new 8" Meade LX90 lowers the cost of living it up!

You can live the good life of big-aperture fully computerized go-to astronomy for less money than ever before with the new 8" Meade LX90.

The 8" LX90 SCT is only \$1695, including a tripod and a go-to Autostar computer with 30,223 stars and objects in its data base.

We have over 150 LX90 scopes on

order for our everyday inventory, so chances are good you can get an LX90 with little or no delay. While backorders are possible on this new telescope, if Meade is shipping the LX90 for a dealer to keep in stock, chances are good we have it in stock.

Meade prices are about the same anywhere you call. So why order a Meade telescope or accessory from a dealer who charges your credit card, then makes you wait and wait until he finally gets around to ordering what you want? Not when you can usually get the Meade you want... right now... at the right price... right here at **astronomics**.

We have the Meade ETX-125EC in stock!



Meade 5" ETX-125EC
\$895

We have over 100 ETX-125EC 5" Maksutov-Cassegrains in stock, with more scheduled to arrive in the near future. You don't have to wait to get an ETX-125EC from **astronomics**.

We've sold over 500 of these 5" computerized Meades during the past year, and 250 of its smaller brother, the 3.5" ETX-90EC. Add in the new 60mm and 70mm ETX refractors, and the Meade ETX scopes make up the most popular family of go-to scopes we carry.

And we don't just have ETX scopes in stock. We have Autostar computers, cases, tripods, eyepieces, electric focusers, filters, camera adapters, and more. If it's any of the Meade ETX scopes, or an accessory for a Meade ETX – or any Meade telescope – chances are good that we have it in stock.

Super second scopes.



Left, Meade ETX-60AT, \$299; above, Meade ETX-70AT, \$349

The new 60mm Meade ETX-60AT and 70mm ETX-70AT refractors hit a new low in pricing for fully computerized scopes... and a new high in value! For less than the cost of many single eyepieces alone, you can have a complete scope – with dual axis motor drives, two eyepieces, built-in go-to computer with 1471 stars and objects in its memory for pushbutton astronomy, and more!

They're ideal as starter scopes, as second scopes for casual astronomy, as vacation scopes, as scopes for the kids. Any way you look at them, these new Meade scopes are winners!

Visit our redesigned and expanded website, now with secure on-line shopping,

www.astronomics.com

3-day air shipping at no extra cost!

We ship by three-day air UPS from our warehouse to our East and West Coast customers at no extra charge above our regular shipping (except for scope cases, Dobsonians, dewshields,

and a few other big items). No matter where you live in the 48 continental United States, your order should arrive by the third business day after we ship. UPS can't guarantee 3-day delivery in

case of bad weather or during peak seasons, so UPS service guarantees do not apply to this limited time free upgrade if shipments are delayed.

Our free catalog helps you pick the right Meade, Celestron, Questar, Takahashi, or TeleVue scope.

For detailed information on individual products, visit our Web site. Or call us at (405) 364-0858, or e-mail us, for your free copy of our catalog AST. It covers all the scopes and accessories we stock – from Apogee, Bushnell, Canon, Celestron, JMI, Lumicon, Meade, Pentax, Questar, Rigel Systems, SBIG, Software Bisque, Taka-

hashi, TeleVue, and more. We'll include our 8-page guide on how to pick the right scope and your discount prices on the 1000+ products we carry. (Sorry, U.S. sales only.) The catalog is yours for only the cost of a one minute phone call. The information we send will make it the most useful minute you'll ever invest in astronomy.

astronomics

Our 22nd year of friendly service, good advice, and money-saving prices.

680 SW 24th Avenue, Norman, OK 73069

Toll-Free Order Line: (800) 422-7876

Catalogs/Questions/Advice: (405) 364-0858

We'll sell you the *right* telescope.

TMB triplet apos!



The first 8" TMB refractors are in the hands of some very delighted customers of ours. Visit our website to see the scopes that are the talk of knowledgeable astronomers everywhere.

TeleVue? We keep it in stock.

TeleVue TV-85, in stock, \$1995



Hardly a week goes by that TeleVue doesn't send us copies of warranty cards filled with the glowing comments written by our customers about the TeleVue scopes they bought from us. But we don't need to be reassured about TeleVue quality. We expect nothing but praise for TeleVue, which is why we stock them in depth. As this was written (10/5), we had dozens of TeleVue scopes in stock, including the TV-101, TV-102, TV-85, Renaissance, Prontos and Rangers galore, and two score more on order.

Pronto, Ranger, TV-85, TV-101, the TV-102 optical tube, the **Renaissance** — all are built to uncompromisingly high optical and mechanical standards. Their short focal lengths give you an observing flexibility many other scopes lack. Each has the ability to go from very low power wide angle views (as low as 9x in some cases, with a wide 5.7° field) to very high power, all without losing optical quality (one test report said they used an amazing 89x per inch of aperture on TeleVue's least expensive model, the Ranger).

In addition to scopes, we stock TeleVue eyepieces, Barlows, mounts, Sky Tour systems, finders, and accessories in depth. If it's from TeleVue, chances are good we have it in stock for immediate shipment.

CCD? We carry Apogee LISÄÄ, Meade, and SBIG.

We stock almost all available models of the Apogee LISÄÄ, Meade, and SBIG CCD cameras and auto-guiders (like the new Apogee LISÄÄ 659 x 494 pixel guider/imager to the left and the self-guiding 1534 x 1020 pixel SBIG ST-8E enhanced blue sensitivity imager shown to the right). Our large inventory means the chances are good you won't have to wait to get the camera of your choice. Here are the cameras and guiders we normally keep in stock and their prices.

Apogee LISÄÄ autoguider or camera ... \$1495⁰⁰
Apogee LISÄÄ camera ... 1395⁰⁰

TMB 80/6 80mm (3.1") f/6 triplet apo	\$1390 ⁰⁰
TMB 80/7 80mm (3.1") f/7 triplet apo	1390 ⁰⁰
TMB 100 100mm (4") f/8 triplet apo	3290 ⁰⁰
TMB 105 105mm (4.1") f/6.2 triplet apo	3290 ⁰⁰
TMB 130 130mm (5") f/6 triplet apo	4990 ⁰⁰
TMB 152 152mm (6") f/6 triplet apo	6990 ⁰⁰
TMB 175 175mm (7") f/6 triplet apo	11,990 ⁰⁰
TMB 180 180mm (7.1") f/6 triplet apo	8490 ⁰⁰
TMB 203 203mm (8") f/9 triplet apo	19,990 ⁰⁰
TMB 254 254mm (10") f/9 triplet apo	34,900 ⁰⁰

This 8" *astronomics* exclusive saves you 55%!

Our C8 Special Edition is built exclusively for us by Celestron, to our specifications. No other telescope dealer has it.

This Special Edition Schmidt-Cassegrain 8" has true multiccoated Starbright optics; setting circles; dust covers; manual slow motion controls; battery-operated DC drive; power adapters for 110 Volt AC and 12 Volt DC; wedge with azimuth adjuster; adjustable height metal tripod; 9 x 50mm finder; 26mm (78x) and 10mm (203x) Plössl eyepieces; an eyepiece Moon filter; and a CD-ROM of Celestron's TheSky Level 1 star charting software for your PC.

You won't find this exclusive package of the most-wanted features and accessories on any other telescope. And you won't find any other telescope dealer with anything approaching this unique Celestron package at this low price. *The Celestron C8 Special Edition is an astronomy exclusive!*

I called the other day to your business to get information on a used S-C telescope. Thinking that the person on the other end would be hesitant to help. I was wrong and your help will insure that all of my future purchases will be with your company.

Customer Quote of the Month #106



\$1299

Our Takahashi sales are now up 263% this year.

Why are more and more people buying more and more Takahashi from us? Is it because we stock more Takahashi than just about anyone else?

While many people swear at the long delivery times quoted by some premium refractor manufacturers, most knowledgeable astronomers swear by the unsurpassed optical quality and fast delivery of the Takahashi apochromatic refractors we keep in stock.



Takahashi FSO-106N OTA (4" f/5), \$3475, on an EM-2 mount, \$2229. Also shown is the FS-102 4" f/8 OTA, \$2349 w/o finderscope.

From the 2.4" FS-60C OTA at \$829 to the 6" FS-152 OTA at \$8999, we stock Takahashi fluorite apochromatic doublet refractors, mounts, and accessories — so we can deliver scopes *fast*. We can also special order larger scopes with 1-3 month delivery times. Why wait for 1-3 years to get your apo refractor or mount from another manufacturer? You can be usually be viewing through a truly superb

Takahashi apo only a few short days after you order from us.

We stock complete Takahashi scopes on USD mounts with 50x sidereal dual-axis slewing, as well as apochromatic optical tubes for use on your own mount.



Arriving this fall is Takahashi's unique **FCL-90 Sky 90** 90mm f/5.6 refractor. With its self-storing dew shield retracted, as shown above, this remarkable scope is less than 14" long! Combined with a compact P2Z mount, it makes a great traveller you can stow away anywhere.

We also stock the 22" long Takahashi **FSQ-106N** 4" 4-element f/5 dual fluorite apo refractor OTA, with retractable lens shade, shown to the far left at \$3475. It's also a great travelling scope. We had 5 in stock as we wrote this on 8/5.

In stock is the unique Takahashi **CN-212** reflector, shown left on a mid-size EM-200 mount (\$6999 on a compact EM-10 mount). It's both a fast 8.3" f/3.9 Newtonian for 35mm and CCD astrophotography and an f/12.4 classical Cassegrain reflector for high contrast visual observing.

If you want a great scope, and you want it *now*, your first choice should be a Takahashi from *astronomics*.

Go-to computerized scopes you assemble in minutes!

CELESTRON

You won't spend hours assembling these Celestron NexStar go-to scopes. They're preassembled, so all you do is slip the scope base into the tripod, hand tighten one large knob, and you're ready to observe ... with no tools needed! You get two eyepieces, a Star Pointer finder, dual motor drives, an adjustable height tripod with accessory tray, and a 4000+ object go-to computer. The **Celestron NexStar 114GT** to the left is a 4.5" aperture 1000mm focal length f/9 reflector. The **Celestron NexStar 80GT** to the right is a 3.1" aperture 400mm focal length f/5 refractor. Both are so sensationally easy to assemble and use that you'll be observing a mere 10 minutes after you get one.



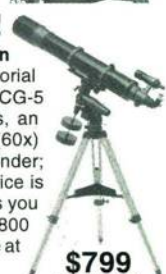
\$858-list
\$499 114GT



\$658-list
\$399 80GT

A 6" Celestron refractor for \$799!

We made a special buy on a very large quantity of **Celestron CR-150HD 6"** (150mm) 1200mm focal length f/8 German equatorial mount achromatic refractors. They come with a heavy duty CG-5 mount that has manual slow motion controls, setting circles, an accessory tray, and an adjustable height metal tripod; a 20mm (60x) Plössl eyepiece; 2x Barlow with integral T-adaptor; 9 x 50mm finder; 2" focuser with 1.25" adapter; and 1.25" star diagonal! List price is \$2390, and normal retail is \$1299, but our buying power saves you \$500 off the regular price! One happy buyer called it "the best \$800 I ever spent in astronomy." We have less than 100 still available at this very special price.



\$799
freight paid!

24-Hour FAX line: (405) 447-3337

Our e-mail address: questions@astronomics.com

Our multiple award-winning Internet address: www.astronomics.com

Our phone lines are open 10 to 7 CST, Monday thru Friday, and most Saturdays from 12 to 5.

Mastercard, Visa, Discover, American Express.

U. S. sales only.

No credit card surcharge. \$6.95 minimum freight. All returns less freight. Restocking fees apply to returns for credit and to merchandise returned used or damaged.

"WE ARE ALL STAR

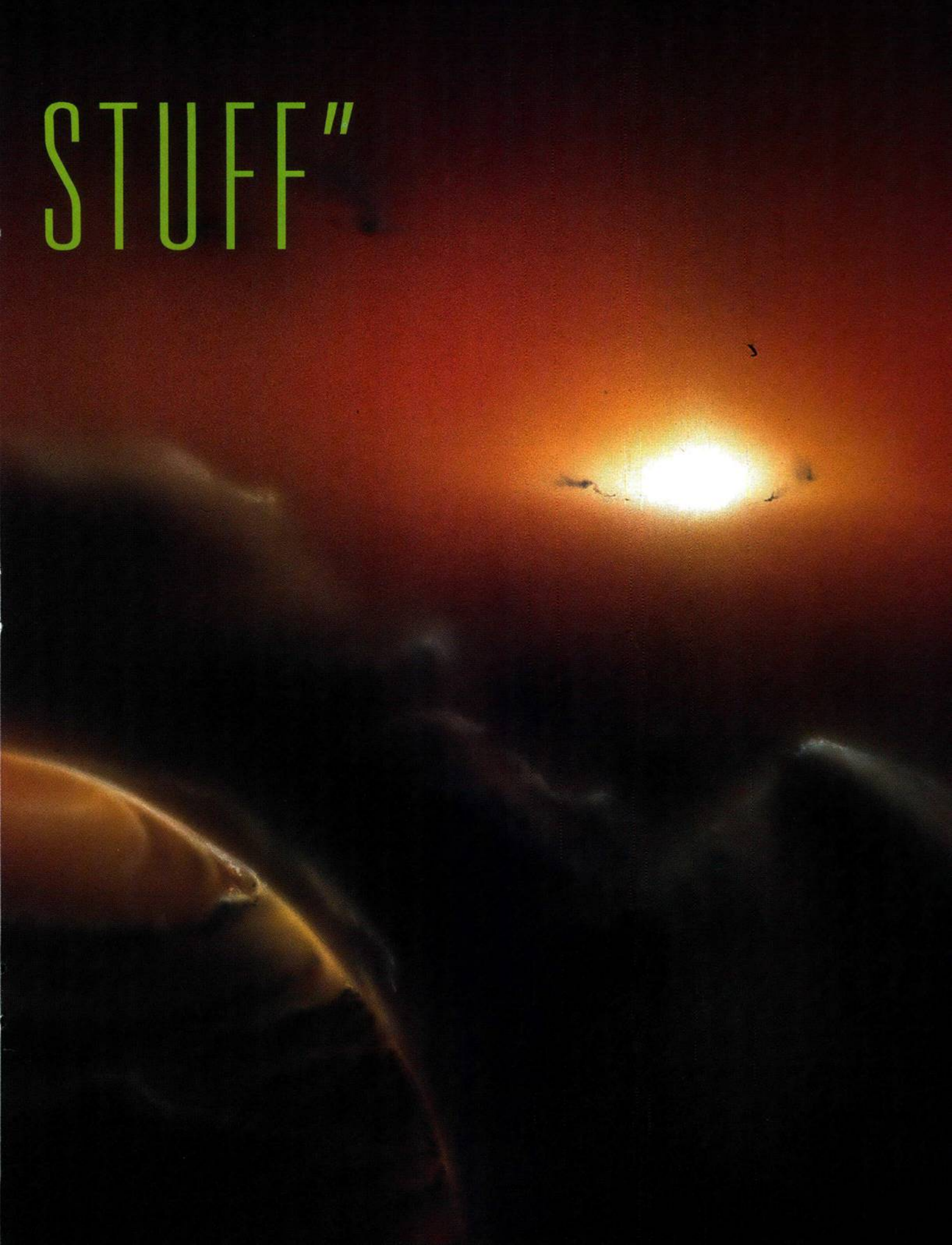
*All living things are composed
of elements created
deep within stellar furnaces.*

by Neil F. Comins

When my children were young, I used to do their night feedings. I can't count the number of times in the middle of the night, watching these wonderfully complex combinations of simple atoms, I marveled at the universe's complexity. It was early one morning in 1991 when one of the connections between life and the cosmos struck home. I was feeding Joshua and casually stroked his cheek. Feeling the warmth and the motion, I couldn't help but wonder about how the elements in Joshua came to be. How did the matter in the universe evolve from its initial hydrogen, helium, and lithium into the variety of elements essential for life?

Clouds of gas and dust coalesce in the early solar system, forming planets and, ultimately, people. Mark Paternostro

STUFF"





I knew the answer, of course, but I had never made the connection between it and our lives as vividly as I did that morning. Somehow it all came down to cars. The first car that I can remember our family owning was a slate-blue 1959 Chevy Biscayne. It had horizontal wings just about as wide as the ones on a Boeing 747. But the combination of a weak, finicky 235-cubic-inch, 108-HP, 6-cylinder engine and the power-hogging two-speed Powerglide transmission gave it little acceleration, making it dangerous to even pass cars on four-lane roads, much less attempt to fly.

The lackluster Biscayne took a back seat to my mother's 1961 sky-blue Thunderbird convertible, powered by a 390-cubic-inch, 300-HP V8. This was the Thunderbird shaped just like a horizontal V2 rocket and virtually identical to the 1963 T-bird featured as the flying car in the remake of *Flubber*. The car accelerated like greased lightning and could run rings around the Chevy. The difference between the two cars was highlighted by the difference in fuel consumption. The powerful T-bird guzzled it, while the Chevy merely sipped leisurely.

Different rates of fuel consumption also characterize how energy is generated in stars and how different elements get into the cosmos. Stars make energy by nuclear fusion. This energy eventually rises through the stars' surfaces and escapes as starlight and other radiation. Energy is only created where the overlying matter

provides enough pressure to heat the star to about 10 million degrees kelvin. At or above such temperatures, various nuclei can be forced close enough together to bond or fuse, releasing energy and forming heavier elements. For example, hydrogen fuses into helium, and helium fuses into carbon. The sun shines due to energy created by hydrogen fusion.

Stars come in all masses, ranging from 0.08 solar mass to about 120 solar masses. All stars begin their lives by fusing hydrogen into helium in their cores. Stars with less than about 0.5 solar mass don't have enough matter to compress the helium further. Once such a star's hydrogen has been fused into helium, fusion stops and the helium star just cools off. More massive stars create enough internal pressure to compress their helium-rich cores until the temperature there is high enough to fuse helium into carbon.

Like more powerful car engines, the fusion rate and the resulting energy output of more massive stars can run rings around the output of the sun. For example, while fusing hydrogen into helium in its core, a star with 10 times the sun's mass emits 10,000 times as much energy per second as the sun. This occurs because their greater mass enables more massive stars to crush inward with more force than can lower mass stars. Greater compression yields greater heating of the core, which in

Stars like the sun recycle starstuff by puffing off their outer layers. Ken Blankenship and Dennis Batis
Red dwarfs such as Barnard's Star will burn like embers for countless eons. Phil Dombrowski

turn leads to more rapid fusion than in less massive stars. While the sun will take about 10 billion years to convert its core entirely into helium, a star with three times as much mass will complete the job in just half a billion years because of the higher fusion rate in the more massive star. The sun is a Chevy Biscayne among stars. This is just as well, because the evolution of a life-supporting Earth takes more time than the entire lifetimes of more massive, Thunderbird-like stars.

When a star's hydrogen core is finally converted into helium, fusion stops there because the core temperature isn't high enough for helium fusion to begin. Helium fusion requires temperatures of at least 100 million degrees kelvin, ten times the fusion temperature for hydrogen. Therefore, the nonfusing core is compressed and heated by the pressure created by the star's ever-present gravity. At the same time, gas in a shell just above the core is being compressed to the point where the hydrogen in it begins fusing. This "shell fusion" creates more helium.

The cores of stars are their most exotic, hottest, and most active regions. Astronomers see in them a variety of elements created by fusion. Though you might think these are the elements we're made of, they're not. The key to our existence is the shells of fusion that



occur outside the core. The star in which we were first leavened had many shells, as we will see.

Eventually, stellar cores become hot enough to fuse helium into carbon. For stars with masses less than about 8 solar masses, this activity is their swan song. When the cores of such low-mass stars are all carbon, fusion stops there and the core never heats up enough to fuse carbon. They slowly shed their outer layers as planetary nebulae, revealing their carbon cores, which we call white dwarfs. Because the outer layers of such low-mass stars consist primarily of hydrogen and helium, they don't have anything to do directly with Joshua's chemistry, or yours, either.

When a star starts out with more than 8 solar masses and evolves a carbon core, it does have enough gravity to compress and heat its core until it begins fusing carbon into nitrogen and oxygen. The temperature just above the carbon core is so high that carbon-core fusion is accompanied by two layers of shell fusion: The helium that was previously created in the shell just outside the core, as described above, fuses into carbon, and, likewise, the hydrogen just above this carbon-forming shell fuses into helium.

When the carbon core entirely converts into oxygen, fusion ceases there and the oxygen core compresses further by the star's gravity. This compression leads to even more fusion outside the core. Then three major shells of fusing matter exist. The inner one, rich in carbon, creates nitrogen and oxygen,

the middle one, rich in helium, creates more carbon, while the outer one begins fusing hydrogen into helium. Other elements, including neon, sodium, and magnesium, are also being created simultaneously in these shells. The oxygen core eventually heats to 1 trillion degrees kelvin and also begins fusing. By now, however, time is running short for the star.

Each time the core converts into a heavier element, fewer atoms are left than were in the preceding cores. For example, after the first core fusion stage only one quarter as many helium atoms occupy the core as the number of hydrogen atoms it previously had. In the next stage only one-third as many carbon atoms exist as there were helium atoms, and so on. This decrease in the number of particles to fuse, combined with higher temperatures in the core at each successive stage, causes the time it takes to convert the core from one element to the next to drop precipitously. Consider a 25 solar mass star. It takes about 7 million years to convert its core hydrogen into helium; about 700,000 years to convert that helium to carbon; about 600 years to convert that carbon into oxygen; about a year to convert that oxygen into silicon; and about a day to convert the silicon core into iron.

In every massive star the core temperature increases each step of the way, reaching nearly 3 trillion degrees kelvin by the time iron forms. Additional layers of shell fusion also develop until the massive star's interior resembles an

Supernovae flung material far into the cosmos and helped to build life. Bill and Sally Fletcher

Blue-white supergiant stars such as Orion's Rigel will one day "go supernova." John Chumack

onion. A variety of elements exists in these shells, but certainly not all the elements that exist on Earth. For example, there is no iron, nickel, copper, zinc, selenium, silver, tin, gold, mercury, lead, or dozens of other heavy elements. Without many of them, such as iron for our blood and for chlorophyll synthesis, copper for enzyme activation and the production of hemoglobin and bone, zinc for enzyme and insulin activity, and selenium for fat metabolism, life would be completely different, if it could exist at all.

The blue-white star Rigel in Orion (his right foot, diagonally across Orion's belt from red Betelgeuse) is an onion-skinned star. The fusion in its core and numerous shells creates 700,000 times as much energy each second as does the sun. The fuel in Rigel's core is nearly gone and the star does not have much more time to shine. In cosmic terms, Orion will "shortly" lose a foot.

The end of stellar evolution for a massive star occurs because iron created in its core absorbs energy when particles fuse with it, rather than emitting energy like other elements. That, as the saying goes, changes everything. The result is catastrophic. At all previous stages, the pressure from the outer

layers caused the core to compress and heat, thereby starting fusion. The energy created by fusion, primarily in the form of gamma rays, provided an outward pressure that stopped the collapse. This is the state of affairs inside the sun today and explains why it is not now collapsing.

Once the core is all iron, fusion ceases. The star's gravity compresses the core, which is another way of saying that gravity supplies the core with energy. This compressed iron quickly becomes so dense that the normal laws of physics that describe the behavior of matter on Earth no longer apply.

As the iron core collapses, many of the electrons in it fuse with protons in the iron. This process converts the protons and electrons into neutrons and particles called neutrinos. Neutrinos are also created copiously in the sun. Neutrinos interact little with normal matter like you and me. Billions of neutrinos from the sun pass through your body every second. Normal matter is nearly transparent to neutrinos just as glass is nearly transparent to visible light. However, the incredibly dense matter in a collapsing, massive star is not transparent to neutrinos. The iron dissociates into neutrons as the core collapses and the neutrinos fly outward into the fusing shells of matter that are following the core inward.

The neutron-rich core falls inward at velocities up to a quarter the speed of light. It collapses from a couple of thousand miles to about 20 miles across in a matter of seconds. Of course, the neutrons are packing closer and closer together during this time, until they reach a density so great (more than ten trillion times denser than water) that a repulsive force between neutrons called neutron degeneracy pressure turns on. This force is powerful enough to overcome the inward rush and cause most of the core to stop and rebound violently.

The rebounding core slams into the shells, as do the neutrinos emitted by it. The outward forces imparted from the expanding neutron core and the neutrinos being absorbed by the incredibly dense shells have the effect of stopping the shells from collapsing and then pushing them outward with great force. All this takes place within a

matter of seconds after the core begins collapsing. The force supplied to the shells is so enormous that their expansion outward is explosive — we call it a supernova. Indeed, the energy released in this type of supernova (there is at least one other kind) is so great that the exploding star can outshine a billion normal stars in its galaxy.

Now comes the part about where the elements in our bodies originate. As you have probably surmised, a variety of relatively light elements found on Earth was produced in the shells before the core collapsed. These include helium, carbon, nitrogen, oxygen, neon, sodium, magnesium, and silicon, among others. But virtually all the iron created in the star exists now as neutrons, and dozens of elements heavier than iron have not been produced in the shells at all — yet.

The pressure exerted by the neutrinos and rebounding core heats the shells sufficiently to drive a tremendous burst of additional fusion in them. As one example, let's see how the iron in our bodies came about. As the shells undergo that burst of fusion, up to half a solar mass worth of a radioactive nickel isotope is created. This nickel decays to radioactive cobalt, which in turn decays to stable iron. Many other fusion reactions are occurring and creating the other heavy elements.

For completeness, it's worth mentioning that the neutron core stops expanding on impact with the shells. The core then recollapses. If it has between 1.4 and 3 solar masses of neutrons, neutron degeneracy pressure will stop its collapse and the core becomes a stable neutron star. If the neutron core contains more than 3 solar masses, even that force can't prevent the neutrons from overlapping, collapsing further, and creating a black hole. These are concentrations of matter so dense that their only effect on the outside comes from their gravitational attractions. Once matter or energy

enters a black hole, it cannot escape. However, the details of what happens to the material entering the black hole are not yet known.

Supernova remnants are among the most spectacular objects in the galaxy. In 1987, a supernova in the Large Magellanic Cloud, a galaxy 160,000 light-years from Earth, was visible to the naked eye in the night sky of the Southern Hemisphere. Nearly 7,000 years ago a star "went supernova" in our own Milky Way Galaxy at a distance of 6,000 light-years from Earth.

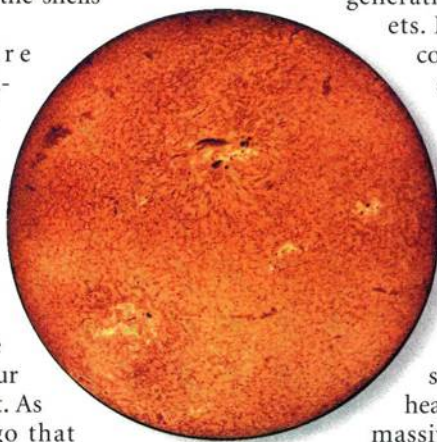
The gas and dust that compose supernova remnants expand free of the core and spread out into the galaxy. Many of the radioactive isotopes in the remnant decay to stable elements, creating even more of the heavy elements that exist on Earth. Eventually enough of this gas cools or clumps together with other interstellar gas to begin recollapsing and forming a new generation of stars and planets.

Earth is an especially concentrated residue of a supernova. Our planet started as gas and dust orbiting the newly forming sun. Lighter elements in our neighborhood, such as hydrogen and helium, were pushed away by the sun, leaving only the heavy stuff created in the massive star and its supernova orbiting and condensing to form the planets Mercury, Venus, Earth, and Mars. If the sun hadn't rid our region of the solar system of the light elements, then Earth would be like Jupiter and the other giants, a planet surrounded by thousands of miles of liquid hydrogen and helium.

The stardust I cradled in my arms was warm and soft. Joshua looked up at me with big blue eyes. While such times are special in and of themselves, they were made even more wonderful for me. While we may not know where we are going, at least science provides us with knowledge about where we came from.

A

Neil Comins, a longtime contributor to Astronomy, is the author of What if the Moon Didn't Exist? and coauthor of Discovering the Universe.



The sun energized the elements in our solar system into complex beings. Jean Dragesco

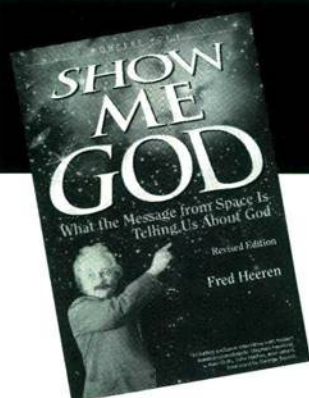
Let's Talk Stars

ASTRONOMY TALK RADIO

WITH YOUR HOST

David H. Levy

LISTEN ON THE INTERNET
WWW.LETSTALKSTARS.COM



Evidence for God?

**THE BOOK
(NEW, REVISED EDITION):**

Show Me God brings together today's top space scientists to talk about how their discoveries affect questions about ultimate origins, the likelihood of extraterrestrials, why we're here, and the nature of God.

- **Stephen Hawking** explains how God relates to his proposal from *A Brief History of Time*.
- **George Smoot** tells why he calls his NASA COBE satellite discovery "fingerprints from the Maker."
- **Alan Guth** describes the universe's "fine-tuning."
- Nobel prize-winners talk about the implications of their discovery of a "creation out of nothing."

With 100 new pages on the search for extraterrestrial life and the latest findings about the early universe, this best-selling book just got better.

This cutting-edge book explores creation where science and religion ask the same questions and think the same thoughts.

—George Smoot, head of NASA satellite team

Brings the latest space results down to Earth—a story well told.

—John Mather, COBE satellite chief scientist

Hardcover: \$22.95. Paperback: \$14.95.
393 pages. 98 photos.

NEW VIDEO: *Evidence for God?*

—Fred Heeren Interviews Today's Top Space Scientists
Hear leading astronomers discuss how their discoveries affect life's big questions.

VHS. 30 minutes.

Regular: ~~\$19.99~~. Intro. price: \$16.88.

NEW MAGAZINE: *Cosmic Pursuit*

For those who want to keep up with the latest on science/faith issues, this quarterly explores cosmic and biological origins, the search for extraterrestrial life, and the source of consciousness and nature's fine-tuning.

U.S. annual subscription price: ~~\$79.99~~

Intro. price: \$19.99 (no extra shipping charges)

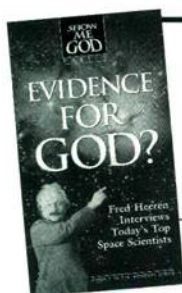
Available at bookstores, or call today:

1-800-743-7700 Visa/MasterCard/Discover

Day Star Publications, 326 S. Wille Avenue, Wheeling, IL 60090

Make checks out to "Day Star" and add \$2.03 for shipping.

See our informative web site at: www.daystar.com.org



IDENTI-VIEW™ PREMIUM GLASS SOLAR FILTERS

- SAFE • HIGH QUALITY
- STRICT CONTROL STANDARDS
- LIMITED LIFETIME WARRANTY

CLASS "A"

Color band - blue. Class "A" filters are made with the same premium quality polished glass and multi-alloy coating as Class "B". An additional steel alloy added to the coating process makes our Class "A" filters extremely scratch and fade resistant. Excellent for visual and photographic use. Light transmission is 1/1000th of 1%.



CLASS "B"

Color band - white. Class "B" filters are made with polished glass and multi-alloy coating. These filters offer great durability and will provide many years of service and enjoyment with normal use. Can be used visually and for photography. Light transmission is 1/1000th of 1%.



CLASS "C"

Color band - red. Class "C" filters are specifically coated to a lighter density (ND-4). They are for photographic use only. This filter is intended for use by professionals and serious hobbyists. Light transmission is 1/100th of 1%.



ORDERING INFORMATION

1. State scope brand and model number, aperture and outside diameter with filter class and price.
2. Make check or money order payable to J.M.B. Inc. All foreign checks must be payable through a U.S. bank.
3. Shipped free within the continental United States. All others add \$5.50 Shipping and Handling per filter. Michigan residents add 6% sales tax, allow 2-3 weeks for delivery.



J.M.B. INC.



736 Oak Glen Circle • Fall Branch, TN 37656
(423) 348-8883 • FAX (423) 348-6389

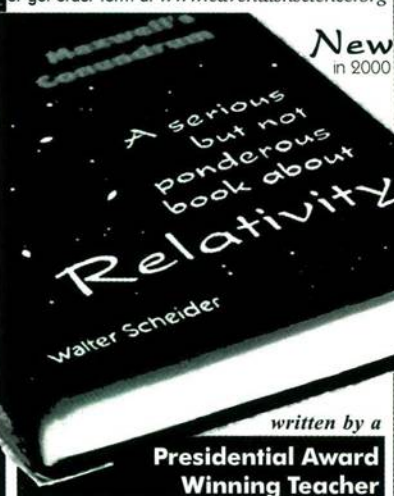
"Imitated but never duplicated"

we'll gift wrap and send it for you

a splendid Gift
for the inquisitive mind

free 3day shipping

Order from the address given below
or get order form at www.cavendishscience.org



written by a

**Presidential Award
Winning Teacher**

for the intelligent non-specialist

- "Highly recommended"
- "clear and engaging style"

—ALA's CHOICE Magazine, Sept 2000

Cloth \$22.95 Paper \$14.95 1-800-247-6553

Cavendish Press PO Box 2588 Ann Arbor MI 48106

www.cavendishscience.org



Destination:

On a craggy volcanic caldera in the Canary Islands stands a collection

Text by Kelly Kizer Whitt and Images





La Palma

of telescopes that will help thrust astronomy into the new millennium.

by Nik Szymanek and Ian King

The Atlantic Ocean hugs the shores of the Spanish archipelago known as the Canary Islands. La Palma, one of the smaller islands, was raised from the sea by volcanic activity. The fertile volcanic soil aids in the export of products such as sugar cane, coffee, oranges, and bananas. One less-traditional commodity produced above the clouds on the rocky crest of the island is astronomical images. With skies that are clear and dark all year, La Palma is one of the best astronomical sites in the world. Its relatively small population (80,000) and isolation off the northwestern coast of Africa helps make light pollution nearly nonexistent. A government regulation called the "Ley de Protección del Cielo" was instituted to preserve these dark conditions.

The 254 square miles of La Palma are unusually steep. The mountain range cutting vertically across the island reaches 6,500 ft in altitude. In the north-central municipality of Garafía, on the rim of the

La Palma Telescope Websites

Carlsberg Meridian Telescope:

<http://www.ast.cam.ac.uk/~dwe/SRF/camc.html>

Dutch Open Telescope:

<http://www.phys.uu.nl/~ruten/dot/>

Nordic Optical Telescope:

<http://www.not.iac.es/>

Swedish Solar Telescope:

<http://www.astro.su.se/English/groups/solar/solar.html>

Isaac Newton Group of Telescopes:

<http://www.ing.iac.es/>

Galileo National Telescope:

<http://www.pd.astro.it/TNG/TNG.html>

HEGRA:

<http://www-hfm.mpi-hd.mpg.de/HEGRA/HEGRA.html>

Isaac Newton Group of Telescopes

PREVIOUS SPREAD: Strung along the mountain ridge on La Palma is the Isaac Newton Group of Telescopes, made up of the William Herschel Telescope (WHT), the Isaac Newton Telescope (INT), and the Jacobus Kapteyn Telescope (JKT). Observing time on this group of telescopes goes mainly to the United Kingdom and the Netherlands, with Spain, Ireland, and Portugal all receiving smaller shares.

Isaac Newton Telescope

TOP LEFT: The Isaac Newton Telescope (INT) is named for the English physicist and mathematician who was the father of modern science. The INT on La Palma saw first light on February 1, 1984. The 100-inch primary mirror is operated entirely by remote control. In 1991, the INT discovered one of the brightest objects in the universe: a quasar 11 billion light-years away and 100,000 billion times brighter than the sun by the name of APM 08279+5255.

Jacobus Kapteyn Telescope

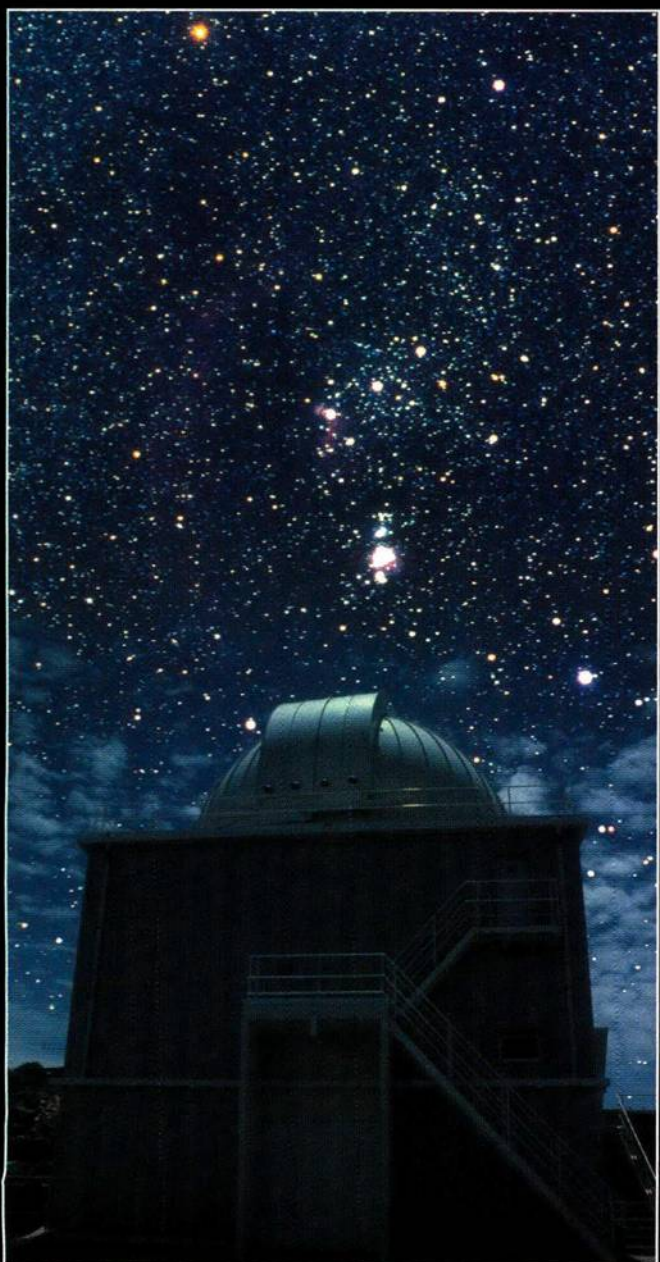
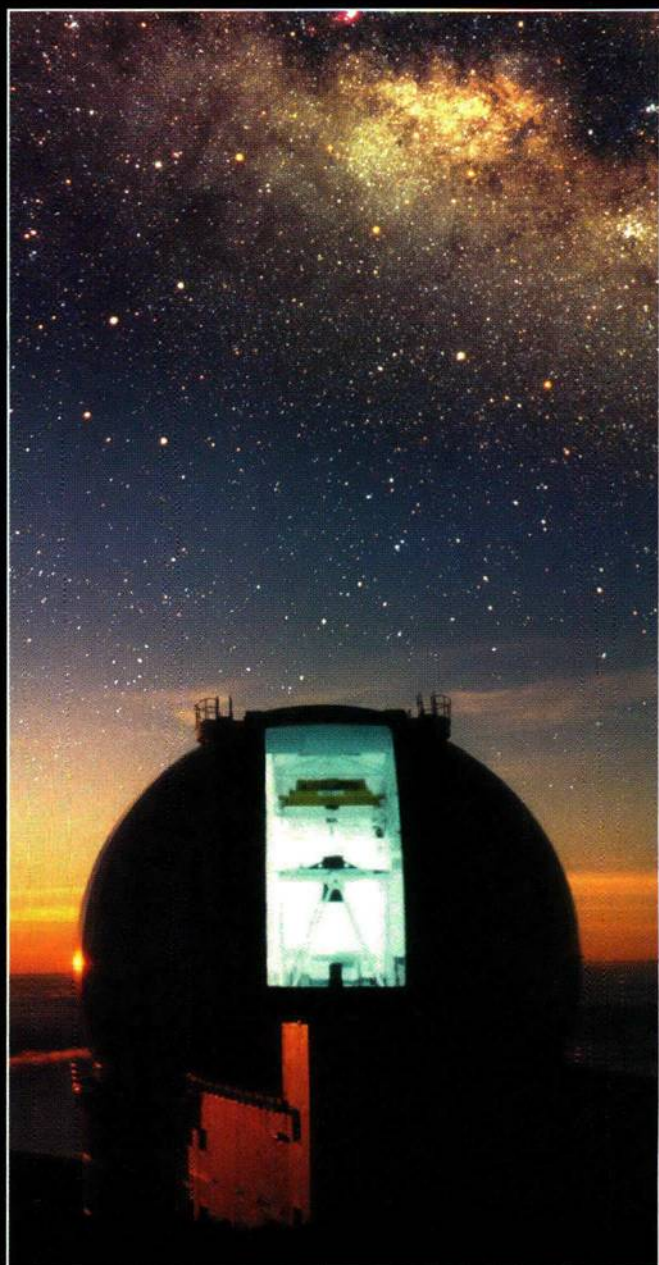
BOTTOM LEFT: Designed for photometry and astrometry, the Jacobus Kapteyn Telescope (JKT) has a 40-inch primary mirror. The telescope saw first light in March 1984. The JKT needs an uninterrupted horizon in all directions so that when an interesting transient object appears, the JKT can always observe it. The National Park Authority that rules the Caldera de Taburiente National Park states that all telescopes must be below the skyline when viewed from Cumbreica so that the beauty of the national park is not destroyed. So the JKT sits south of and 72 feet above the INT, close to the caldera's edge.

William Herschel Telescope

TOP RIGHT: The largest telescope in Observatorio del Roque de los Muchachos, the William Herschel Telescope (WHT), is also the largest telescope of its kind in Western Europe, with a 165-inch single mirror. The man for whom the telescope was named was a musician with no formal astronomy training. Yet he discovered the planet Uranus among other great accomplishments. Following in its namesake's footsteps, the WHT has made great discoveries, including the observation of the coldest known star, a binary in WZ Sagittae that is not hotter than 3,600° F.

Dutch Open Telescope

BOTTOM RIGHT: The Dutch Open Telescope (DOT) resembles a water tower more than an observatory. Its design is meant to improve image quality by having the 50-foot tower open to air turbulence and above the warmer boundary layer of Earth's atmosphere. The design allows for the installation of a 28-inch primary lens, but currently it is outfitted with an 18-inch solar instrument. The telescope is used for high-resolution mapping of solar magnetic fields.

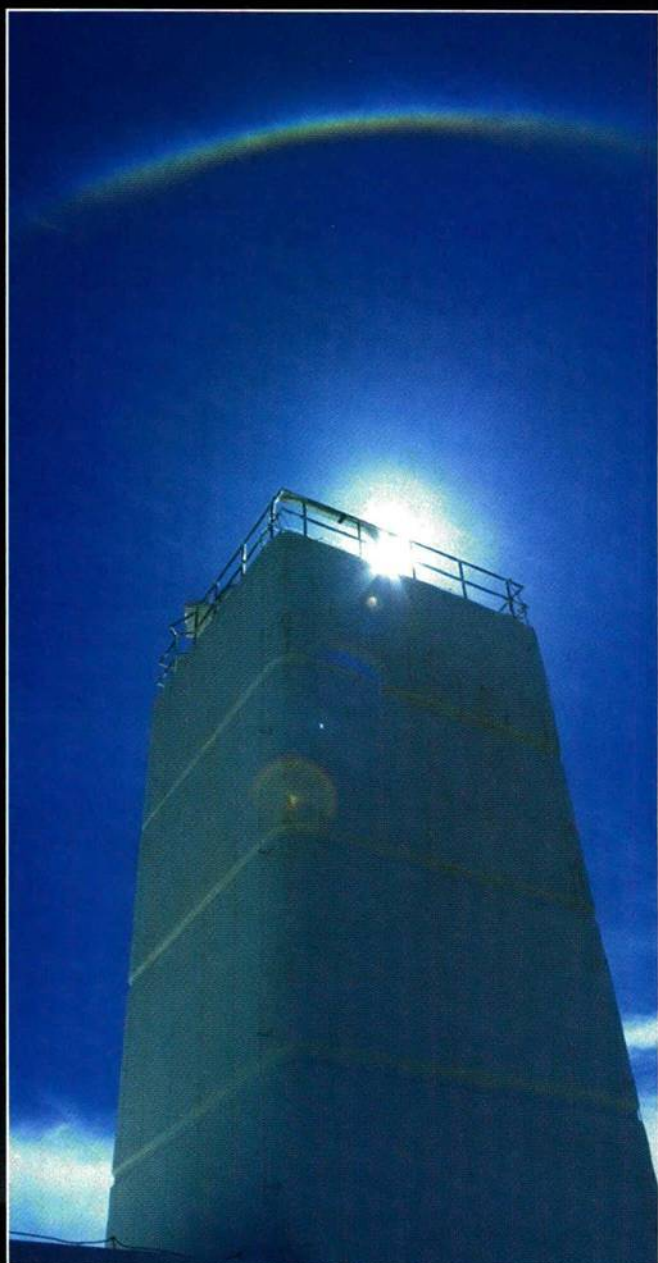
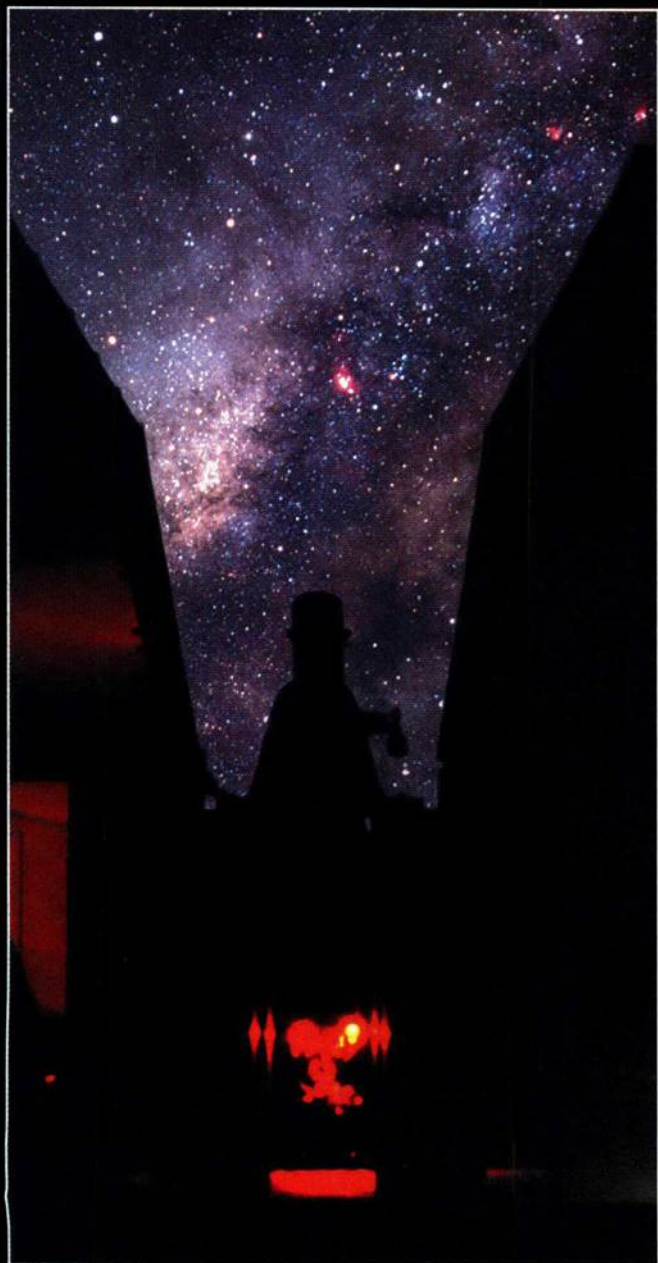


Nordic Optical Telescope

RIGHT: The Nordic Optical Telescope (NOT) observes in optical and infrared wavelengths. A collaboration of Denmark, Finland, Iceland, Norway, and Sweden, the project achieved first light in late 1988. In early 1996 the NOT became the first telescope on La Palma to have a CCD in regular operation. The NOT discovered the optical counterparts of two gamma-ray bursts in 2000.

Carlsberg Meridian Telescope

BELOW: The Carlsberg Meridian Telescope (formerly the Carlsberg Automatic Meridian Circle) was one of the first fully automatic telescopes in the world. The optical observing is controlled through the Internet, and no on-site staff is employed. Britain, Denmark, and Spain are all partners in its operations. In 1998 a CCD was installed and current research involves mapping the northern sky to acquire accurate positions of stars that will bridge the gap between the work of Hipparcos and the fainter stars from old photographic plates.



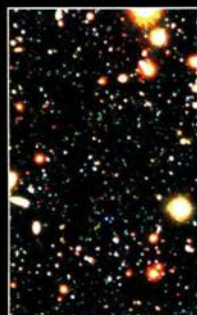
Recording the Sky from La Palma

Professional astronomers have made numerous discoveries from the telescopes on La Palma and have captured innumerable beautiful images. Below is a small selection of images from the William Herschel Telescope (WHT). The images are courtesy of the Isaac Newton Group of Telescopes, La Palma.



The "Ghost of Jupiter," NGC 3242, is a planetary nebula with an almost spherical outer shell and elliptical inner ring, creating the look of an "eye." Taken with the WHT, you can also glimpse the central illuminating star in the image.

Javier Méndez, ING



The WHT Deep Field is a 70-hour exposure of a 7' by 7' patch of sky in Pisces. The brightest objects are stars, but the rest are very distant galaxies, indicating that the era of galaxy formation was even further in the past than once thought. The image is 10 times larger than the Hubble Deep Field.

Nigel Metcalfe and Tom Shanks (University of Durham), ING



The barred galaxy M100 (NGC 4321) is part of the Virgo cluster. The WHT took infrared and optical images of M100 that suggest a barlike structure hides inside this spiral galaxy.

J. E. Beckman, R. F. Peletier, J. H. Knapen, R. L. M. Corradi, L. J. Gentet, ING

Swedish Solar Telescope

LEFT: The 20-inch Swedish Vacuum Solar Telescope (SVST) that sat on La Palma since 1985 was taken down on August 28, 2000, to make way for the New Swedish Solar Telescope, which will have twice the aperture (about 36 inches). First light is expected in 2001. Run by the Royal Swedish Academy of Sciences, the new facility will be equipped with adaptive optics and used in solar and planetary studies. The recently dismantled solar telescope had already been used for objects positioned within 45° of the sun, a range that telescopes such as Hubble are unable to cover. In December 1995 Jupiter sat just 9° from the sun, and the telescope observed the cloudy jovian environment that the Galileo Probe was about to encounter.

Caldera de Taburiente National Park, stands one of the largest collections of telescopes in the world. The highest point (7,959 ft) is the Roque de Los Muchachos, which gave the group of telescopes its name: Observatorio del Roque de Los Muchachos. At the altitude of the observatory, temperatures can vary from 64° F in summer to 37° F in winter. The telescopes operate year round.

Nine telescopes currently are in use at the observatory. They include the Carlsberg Meridian Telescope, Dutch Open Telescope, Nordic Optical Telescope, Swedish Solar Telescope, Galileo National Telescope, HEGRA (a gamma-ray facility), and the three telescopes in the Isaac Newton Group of Telescopes: the William Herschel Telescope, Isaac Newton Telescope, and Jacobus Kapteyn Telescope. (The Galileo National Telescope and HEGRA are not pictured in this article.) Access to the observatory is limited. Only at certain times during the summer do the organizations responsible for the telescopes hold "Open Days" when tours are available. The island itself is not easily accessible, with options consisting of infrequent direct flights from Madrid or chartered flights from Germany, the Netherlands, Switzerland, Tenerife, and Gran Canaria. A ferry also occasionally runs from Tenerife to La Palma. The easiest (and most inexpensive) way to view the observatory's telescopes and glimpse the dark sky from La Palma is through photographs of those who have made the effort to visit.

A

sky Show

january

Begin your 2001 space-observing odyssey
with some solar system delights.
by Martin Ratcliffe and Alister Ling

► Planning your observing around the moon is a great idea when you want to revel in the treasures of deep space or see a meteor shower. But this month you should also plan *for* the moon.

Keep an eye out for the always endearing conjunction of Venus and the crescent moon on the evening of December 29th, which will be followed by a more beautiful conjunction again on January 28th. In this month's orbit around Earth, the moon swings past Saturn and Jupiter in our sky on the 5th and 6th, through Earth's shadow for an eclipse on the 9th, then up through the Beehive Cluster (M44) on

the 10th, above Mars on the morning of the 16th, and back below bright Mercury by the 25th.

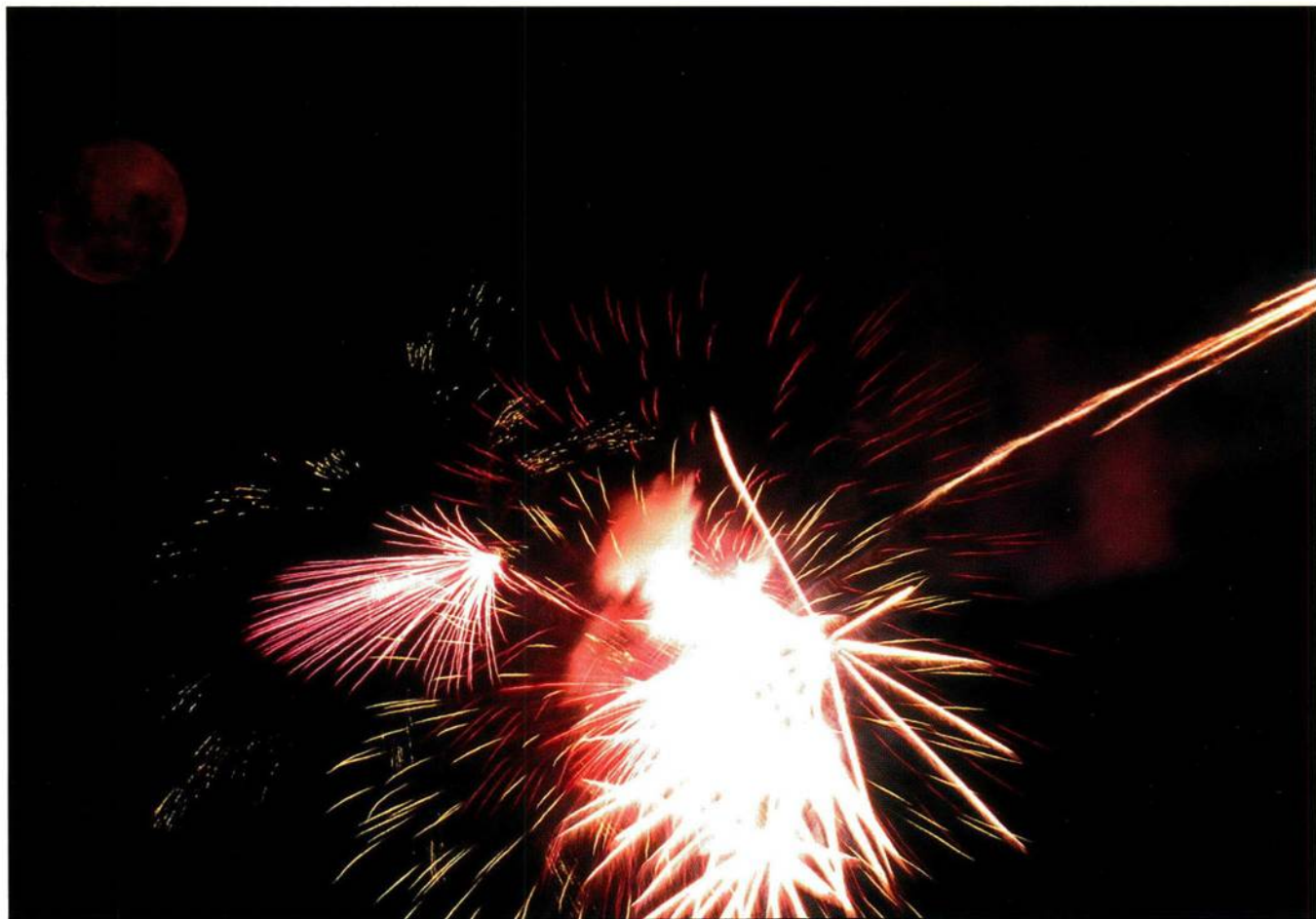
The moon does not orbit around Earth's equator, in contrast to many moons of other planets. Instead it makes a slight angle with the ecliptic, the nearly level "playing field" of the solar system. That's why we do not see an eclipse every month. With all the lunar events this month, you can see that its orbit is indeed tilted a bit. For half its cycle it lies below the planets, and in the other half it's above them.

If you missed out on millennial fireworks, January's Quadrantid meteor

shower, probably the fourth best shower of the year, peaks before dawn on the morning of the 3rd. Bundle up and enjoy the shooting stars, because this short-duration shower favors North Americans this time around. It occurs a day early because of the leap year in 2000.

A stunning sight in the winter skies is the pairing of Jupiter and Saturn near Aldebaran and the Pleiades. A scan with binoculars reveals rings, moons, and otherwise hidden stars.

The new year will bring a lunar eclipse and possibly a fireworks display. Steven Michael Starnes



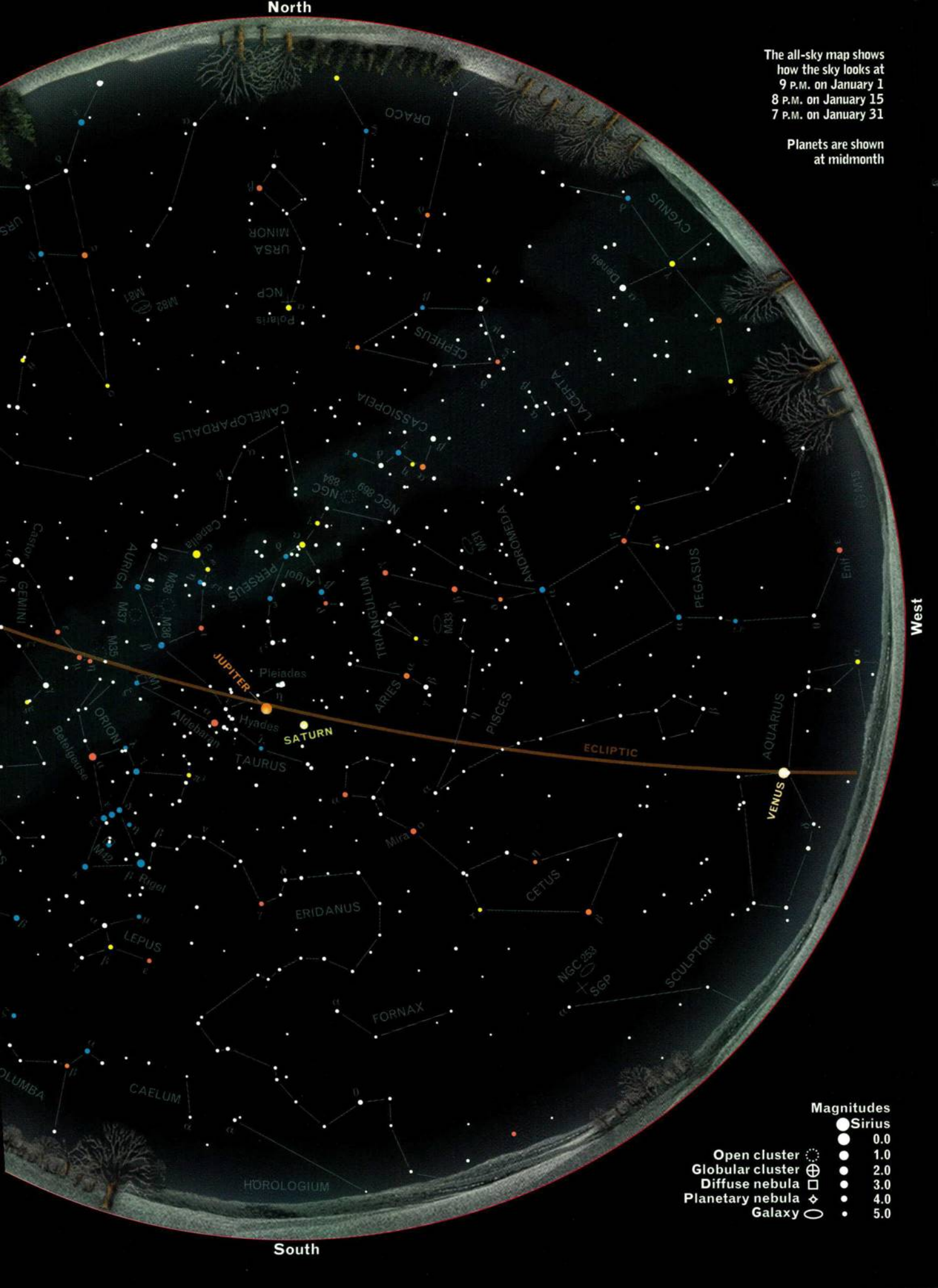
2001 January

- 2 First quarter moon is at 5:31 P.M. EST
- 3 Quadrantid meteor shower peaks (page 76)
- 4 Earth is at perihelion (91.4 million miles from the sun), 4 A.M. EST
- 5 The moon passes 2° south of Saturn, 8 P.M. EST
- 6 The moon passes 3° south of Jupiter, 9 A.M. EST
- 9 Full moon is at 3:24 P.M. EST; total lunar eclipse (page 76)
- 10 The moon is at perigee (221,910 miles from Earth), 4:01 A.M. EST
- 13 Mercury passes 2° south of Neptune, noon EST
- 16 Last quarter moon is at 7:35 A.M. EST
- 17 Venus is at greatest eastern elongation (47°), 1 A.M. EST (page 74)
The moon passes 4° north of Mars, 3 P.M. EST
- 20 The moon passes 0.7° north of Ceres, 11 P.M. EST
- 22 Mercury passes 0.4° south of Uranus, 1 P.M. EST
- 24 New moon is at 8:07 A.M. EST
The moon is at apogee (252,626 miles from Earth), 2:05 P.M. EST
- 25 Jupiter is stationary, 10 A.M. EST
Saturn is stationary, 11 A.M. EST
The moon passes 3° south of Mercury, 10 P.M. EST
Neptune is in conjunction with the sun, 11 P.M. EST
- 27 The moon passes 0.8° north of Vesta, 6 A.M. EST
- 28 Mercury is at greatest eastern elongation (18°), 8 A.M. EST (page 74)
The moon passes 6° south of Venus, 9 A.M. EST

SUN.	MON.	TUE.	WED.	THUR.	FRI.	SAT.
						
						
						
						
						

East

This map portrays the sky at times shown in the upper right corner of the page. Located just outside the map are the four directions: north, south, east, and west. To find stars above your horizon, hold the map overhead and orient it so a direction label matches the direction you're facing. The stars above the map's horizon now match what's in the sky.



The all-sky map shows
how the sky looks at
9 P.M. on January 1
8 P.M. on January 15
7 P.M. on January 31

Planets are shown
at midmonth

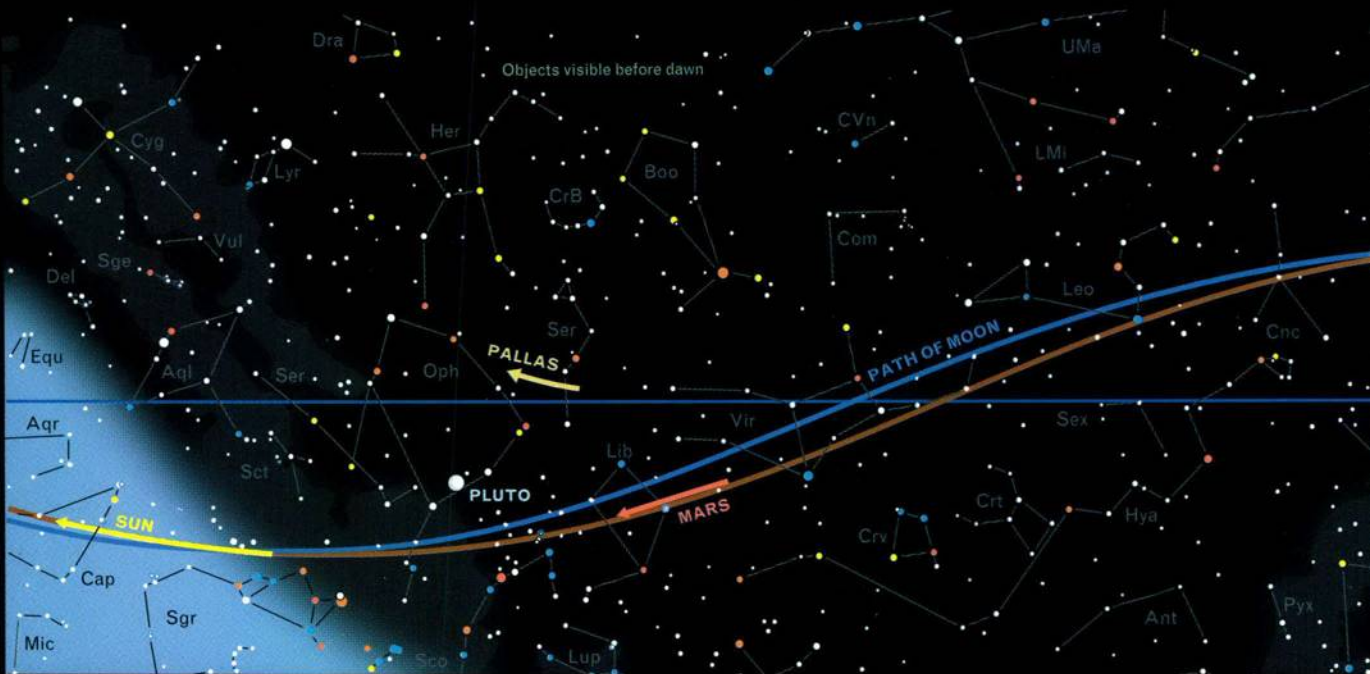
West

- Magnitudes**
- Sirius 0.0
 - 1.0
 - 2.0
 - 3.0
 - 4.0
 - 5.0
- Open cluster ☉
Globular cluster ⊕
Diffuse nebula □
Planetary nebula ◇
Galaxy ○

South

Path of the Planets

This map unfolds the entire night sky from evening (at right) until sunrise (at left). Arrows and squares show the movements and locations of solar system objects.



To locate the moon in the sky, draw a line from the phase to the ecliptic.

PLANETS

Date
Magnitude
Angular Size
Illumination
Distance (AU) from Earth
Distance (AU) from Sun
Right Ascension (2000.0)
Declination (2000.0)



MERCURY

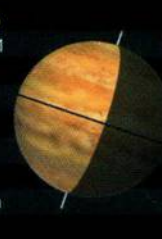
January 15
-0.9
5.3"
91%
1.271
0.379
20h41.2m
-20°17'

MERCURY

January 31
-0.2
7.5"
43%
0.895
0.308
22h04.3m
-11°01'

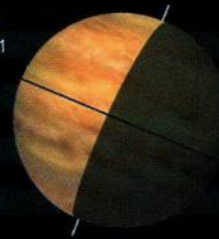
VENUS

January 1
-4.3
20.7"
59%
0.806
0.723
21h58.8m
-13°57'



VENUS

January 31
-4.5
28.5"
43%
0.585
0.719
23h48.8m
0°14'



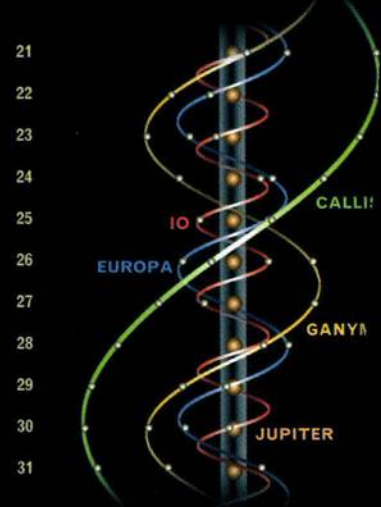
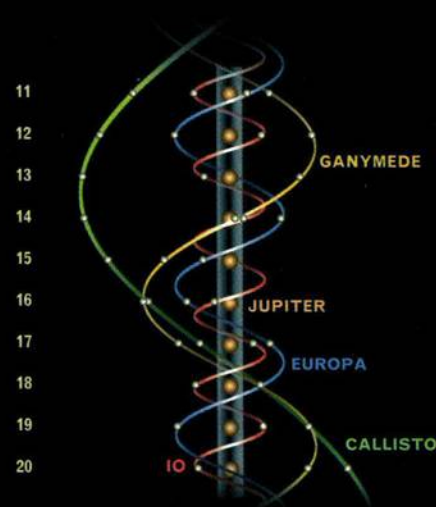
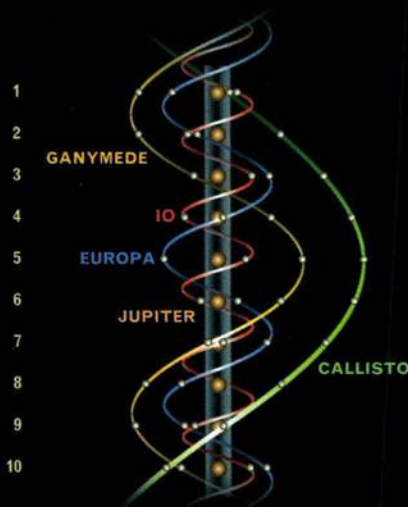
MARS

January 15
1.2
5.7"
91%
1.654
1.640
14h43.8m
-14°36'

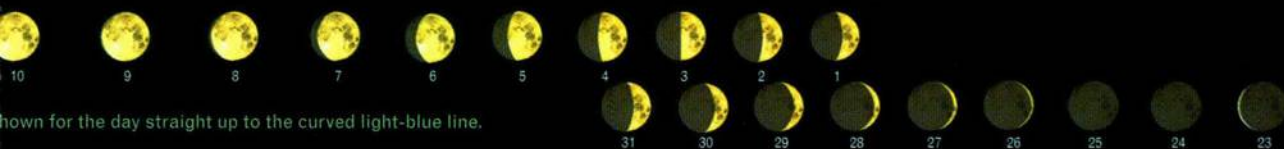
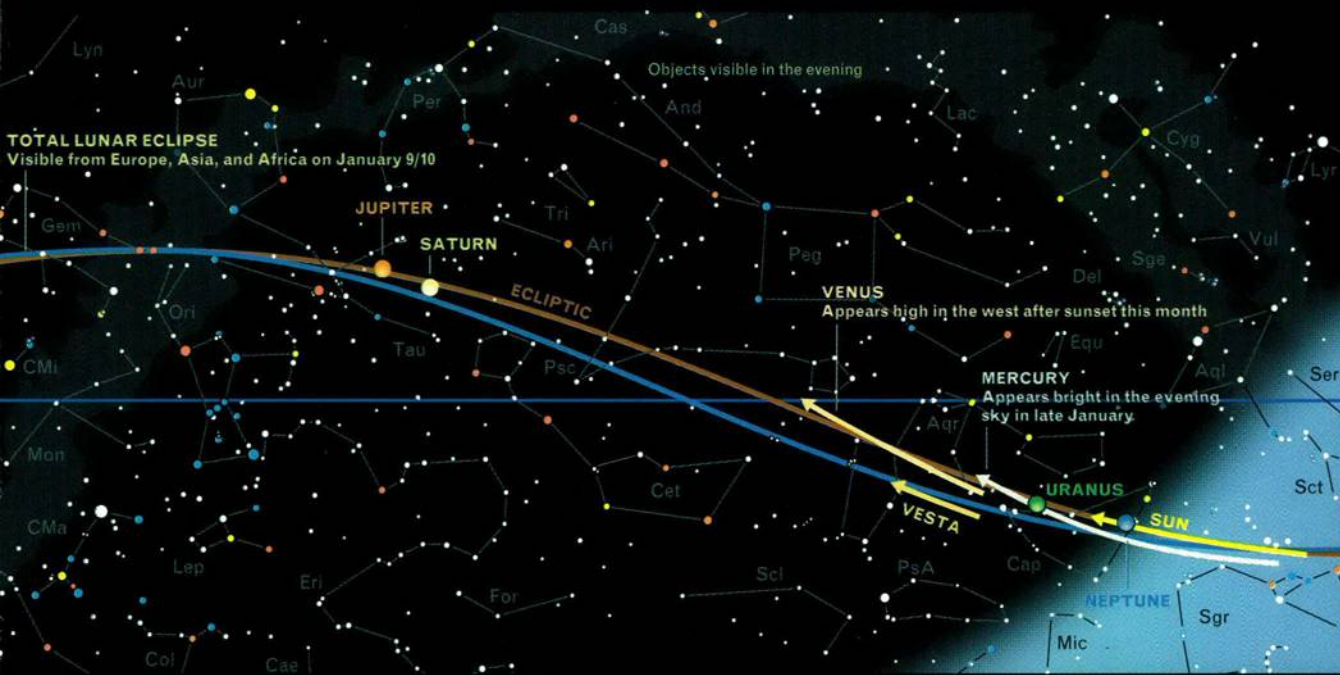


Jupiter's Moons

Dots display positions of Galilean satellites at 10 P.M. EDT on date shown. South is at top to match the view in a telescope.

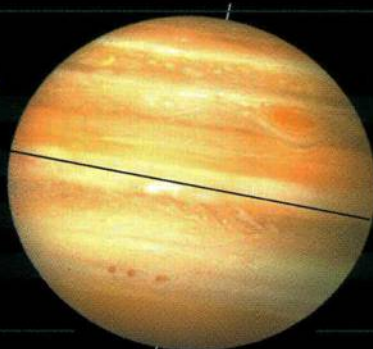


during the month.



JUPITER

January 15
-2.6
44.8"
99%
4.403
5.050
3h57.6m
19°42'



SATURN

January 15
0.0
19.3"
100%
8.590
9.111
3h29.3m
16°44'



URANUS

January 15
5.9
3.4"
100%
20.850
19.959
21h28.0m
-15°39'

NEPTUNE

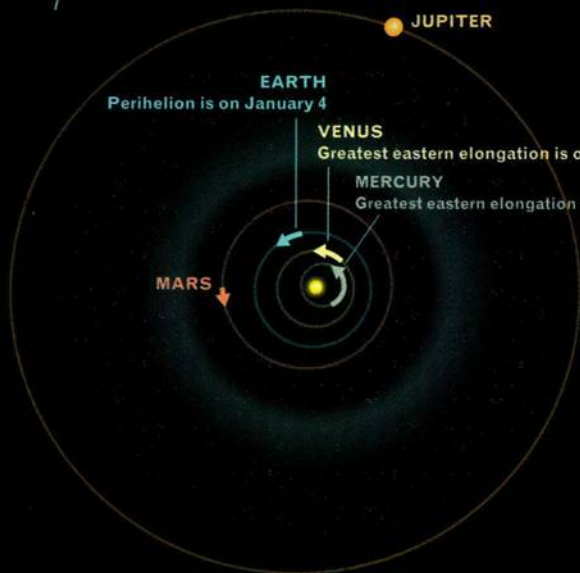
January 15
8.0
2.2"
100%
31.073
30.107
20h32.6m
-18°39'

PLUTO

January 15
13.9
0.1"
100%
31.069
30.342
16h56.5m
-12°14'

The Planets in Their Orbits

Arrows and dots show planets' positions during the month.



Epsilon Eridani: A Nice Place to Live?

One of the newest solar systems on the block is quite nearby — we can even see its sun with the naked eye. Magnitude 3.7 Epsilon (ε) Eridani lies 27° due south of Jupiter (that's a bit more than a fully stretched handspan at arm's length).

We don't know what this planet in another solar system holds. But its home sun, Epsilon Eri, is a relatively unremarkable star, which actually makes the system capable of supporting life. Through the eyepiece, Epsilon Eri appears as a pale yellow-peach dot. But there's a lot to be excited about. Firstly, it's a sunlike star, albeit a bit smaller and fainter than our own. Secondly, Epsilon Eri is quite nearby, only 10.5 light-years away. Thirdly, its Jupiter-size planet is at a distance similar to our asteroid belt, which means any smaller planets closer in could be in stable orbits. The real pity is that we'll have to wait a long time before we can take a really good look.

But meanwhile, let your imagination do the traveling.

In Its Heart Lies a Monster

Deep in the core of the spiral galaxy M77 in Cetus a suspected gargantuan black hole powers the galaxy's mind-boggling energy output. Its blazing pinpoint core led the American astronomer Carl Seyfert to study M77 in more detail. Spectra of the now-named Seyfert galaxies (such as M77) show strong emission lines of ionized atoms, betraying the existence of a huge central energy source. Like many active galaxies, M77 is also a strong radio emitter.

In 1780, M77 was brought to the attention of famed comet hunter Charles Messier by his assistant Pierre Méchain. Whereas Messier described most galaxies as simply "nebulae," he saw in M77 a "cluster of small stars which contains some nebulosity." This suggests that you will see more than a



M77 is a spiral Seyfert galaxy in Cetus with a powerful core. John Chumack

fuzzball in your telescope, which is high-tech compared to Messier's primitive instruments.

M77 is relatively straightforward to find. First locate the three brightest tail stars of Cetus the Whale, to the lower right of Jupiter and Saturn in mid-evening. From Delta (δ), the lowest of the three, slide 50', a bit less than two moonwidths, to the east-southeast (lower left). The bright core of M77 will be noticeable as a fuzzy "star."

To see more detail, get out under a moonless, dark country sky, where the surrounding envelope of the galaxy's disk becomes visible. The important point to remember about seeing detail is to use lots of magnification. With a 4-inch scope try and push past 150x, and with a 10 inch, past 300x. The central area of M77 is bright and can readily withstand even more power in larger scopes. The trick is to place your head under a dark cloth at the eyepiece and spend several minutes scanning the disk. Although most amateurs will need more than a 12-inch telescope to see spiral structure, a patient observer can notice some mottling with a 5 incher. Afterward, switch to M32, one of the Andromeda Galaxy's companions, and you will see that it looks very smooth by comparison to the lumpiness of M77.



Looking southeast
7 P.M., mid-January

Bright Planets Announce a New Year

Brilliant planets are on display every clear January evening, providing great opportunities for that new telescope you received over the holidays. **Venus** sparkles in the west-southwest and provides a dazzling beacon as it sets in the cold evening hours. The king of the planets, **Jupiter**, and its slightly smaller sibling, **Saturn**, lie high in the south-east as the sky darkens. The three planets add brilliance to an already star-studded winter sky that includes the constellations Orion, Taurus, Gemini, and Canis Major — home to Sirius, the brightest star in the sky.

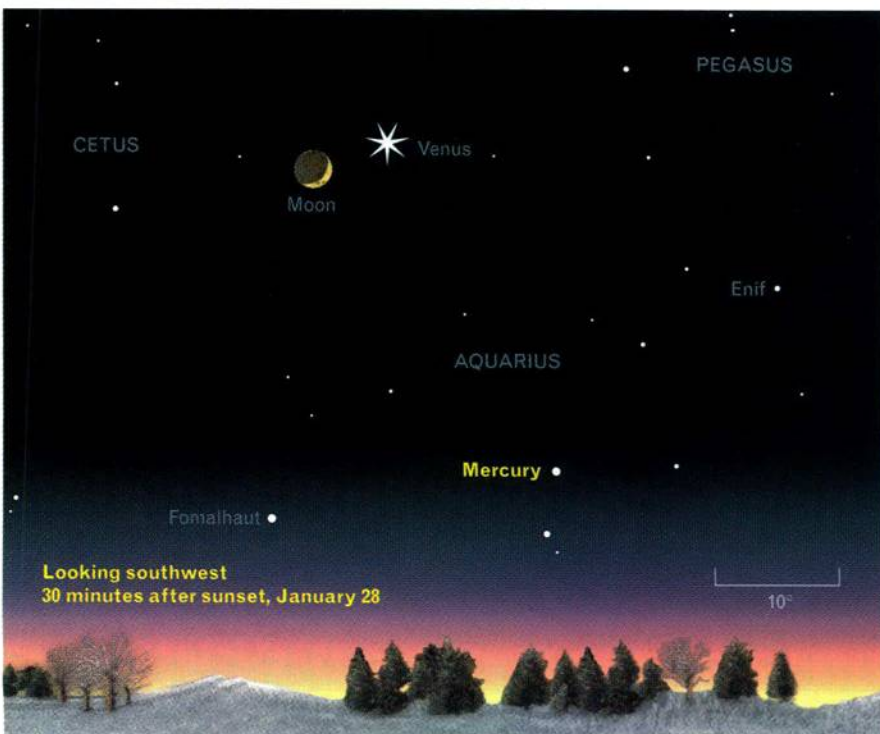
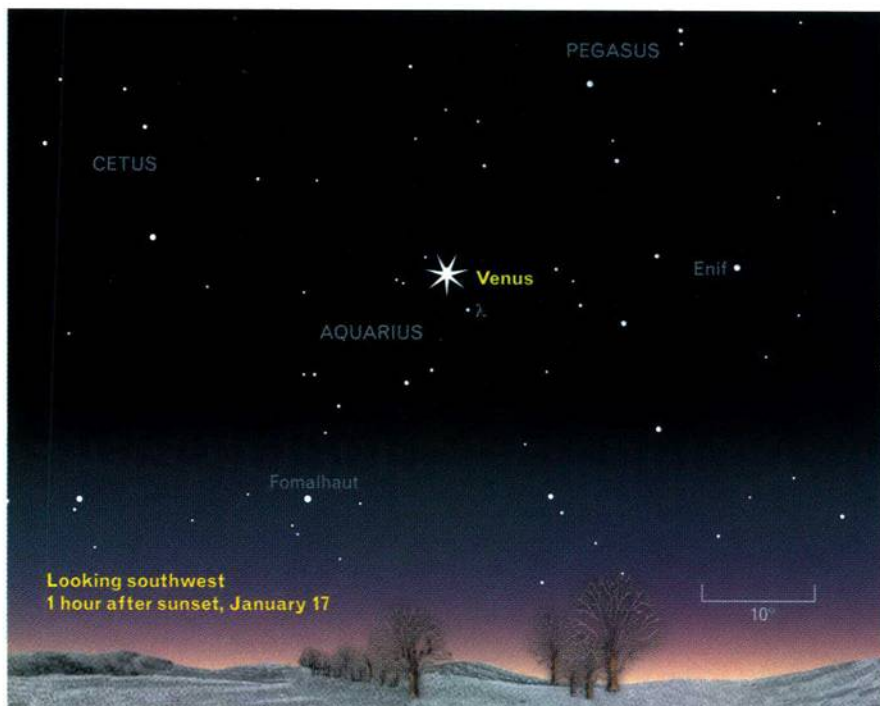
Venus outshines them all, aside from the moon, of course. Its brilliance peaks toward the end of the month at magnitude -4.5 . Venus reaches its greatest elongation from the sun on January 17 — a span of 47° separates our view of the sun and Venus. It's around this date that Venus takes on a "half-moon" phase, appearing rather like a first-quarter moon when viewed through a telescope. On what date does Venus look exactly 50-percent lit to you? By the end of January Venus begins to take on a crescent shape.

Venus lies among the faint stars of Aquarius for most of January and sets four hours after the sun. Coincidentally, Venus lies in the same position in the sky that Mars was in on the same date a year ago. Venus passes close to the magnitude 3.9 star Lambda (λ) Aquarii on January 14. On this night Venus might appear as though it has acquired a faint moon when viewed through binoculars. On its way into Pisces during the last week of the month, Venus lies near a crescent moon. Look for Venus lying high above the horns of the moon on January 27, while the following night an Earth dweller will see the moon to the left of Venus. Incidentally, our moon's motion is a product of its monthly orbit around Earth.

January 28 also is the date of **Mercury's** fleeting appearance when it lies at its greatest eastern elongation of 18° . (See diagram at right.) Always a difficult object because it never journeys far from the sun, Mercury stays above the

horizon for a full 90 minutes after sunset. Look for it shining at magnitude -0.6 just above the tree line low in the west-southwest. For those with perfect skies to the west, try spotting the

young crescent moon 4° (eight moon-widths) below Mercury a couple days earlier on January 25. The moon is only one day past new on this date and sets soon after the sun.



A pair of giant planets occupies the same region of sky as Taurus the Bull during January. Both Jupiter and Saturn are high in the southeast by nightfall. Jupiter is unmistakable. It's the brightest object in the sky after the moon and Venus. Shining at magnitude -2.6 , Jupiter provides a stunning jewel lying adjacent to the cascade of diamonds that form the Seven Sisters (M45, the Pleiades star cluster). Saturn lies 7° to the southwest of Jupiter and is fainter at magnitude 0. Both planets are spectacular through any telescope. Let's take a look at each one in turn, starting with Jupiter.

Almost any telescope will show at least two dark bands across Jupiter's visible face. These are the famous north and south equatorial belts. Most other features on Jupiter appear subtle in comparison. To see the finer details requires patience plus a steady atmosphere. If stars are twinkling rapidly near the horizon, your views of the planets will remain somewhat blurred, especially at higher magnification.

Watch for changes in the Great Red Spot and the surrounding white storm clouds. John Chumack

Fans of the Clarke and Kubrick movie *2001: A Space Odyssey* might be watching for a dark-black monolith among the clouds of Jupiter. While it's highly unlikely that such an observation will occur this year, Jupiter can pop a few surprises of its own from time to time. The dramatic winds that circle the giant planet in less than 10 hours stir up tumultuous storms. Giant white and dark spots come and go, some in a matter of days or weeks. Tracking these ever-changing storms is of tremendous interest to scientists, and most major features are well within reach of amateur scopes. The best known feature is the Great Red Spot — its prominence varies each year depending on the activity of this giant storm system.

Saturn's faint appearance near Jupiter belies its beauty. Its atmospheric features are no match to Jupiter's, but Saturn's bright ring system has no equal. Small telescopes will show the rings, even at low power. Look for the Cassini Division, a black gap in the ring system. It's thought to be caused by resonance between the orbits of a number of Saturn's moons, which gravitationally interact in such a way that makes

any particles stay out of the gap. The rings tilt 23° to our line of sight, and currently this presents us with a fine view of the south pole of the planet.

Although Saturn's disk is a lot smaller than Jupiter's, spanning only $19''$, some detail can be seen on occasions. In particular, be on the lookout for white spots or clouds — these would appear as brilliant white regions that shine in contrast to the rather dingy ochre of most of Saturn's globe. Atmospheric features on Saturn are less well defined than on Jupiter due to a haze layer that reduces the contrast.

The easiest natural satellite of Saturn's to spot is Titan. This satellite can be found circling the planet every two weeks. Larger telescopes may pick up the yellowish glow of Titan, a color induced by its thick atmosphere — the only moon in the solar system known to retain a significant gaseous envelope.

Although close together in the sky, the two giant planets are far from each other in reality. One way of comparing their distances is by measuring the time it takes light that has reflected off the planet to travel the long distance to Earth. In the case of Jupiter, this currently amounts to 36 minutes. Saturn is almost double the distance of Jupiter, so the one-way light travel time is 71 minutes. With this in mind, watch as our moon, a mere one-and-a-quarter of a light-second away, passes both Saturn and Jupiter on January 5 and 6.

Mars continues to brighten slowly as it makes its sedate way to opposition, which occurs in six months. By the end of the month Mars reaches a respectable magnitude 1.0. This is fractionally brighter than its rival, Antares, the brightest star in Scorpius the Scorpion. Scorpius rises in the southeast about two hours before dawn, and Mars rises earlier, climbing above the horizon by 2 A.M. local time at the end of January. Telescopically Mars remains a disappointment due to its tiny apparent size. The disk subtends a mere $6''$ — it will be a few months before Mars has any easy feature to look at, although the tiny Red Planet is always a challenge, even around opposition.



Low-Key Quadrantids

This annual shower is active from January 1 through January 5, peaking on January 4. It is named after a defunct constellation, Quadrans Muralis, and the radiant lies in part of the northern region of Boötes the Herdsman. The shower is best viewed before dawn when the radiant is at its highest above the horizon for Northern Hemisphere viewers. The first-quarter moon collaborates nicely, setting shortly after midnight and yielding a dark sky for those who live away from encroaching streetlights. The shower produces variable rates of meteors, from 60 per hour up to 120 per hour for brief periods. This year's shower is certainly worth watching.

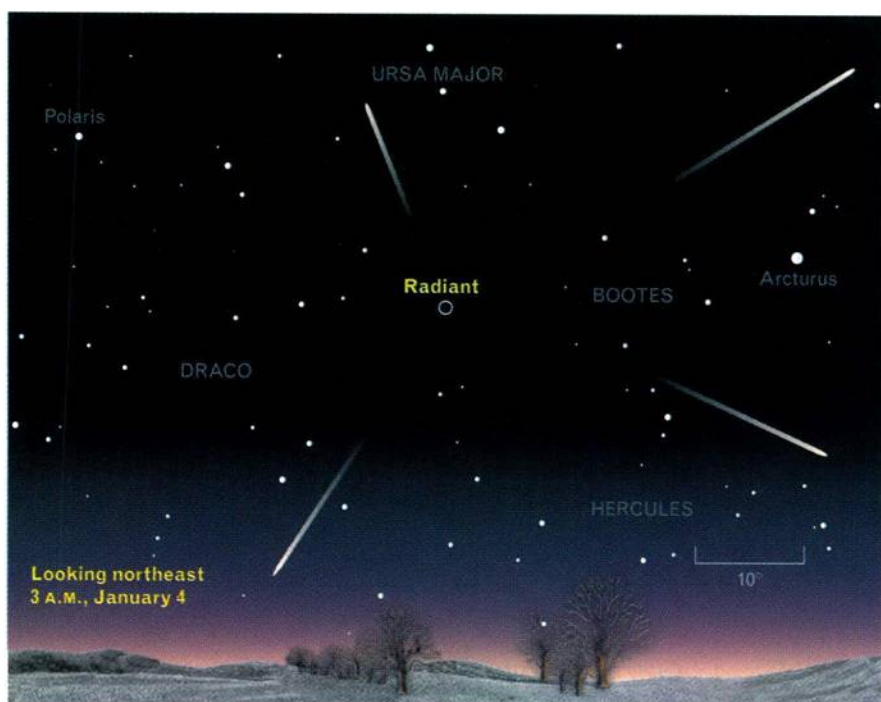
Lunar Eclipse

The moon undergoes a total eclipse this month, a year after a similar event that occurred for North American viewers. This year it is Europe's turn, with the major part of the eclipse occurring between 2:50 P.M. and 3:52 P.M. Eastern Standard Time — daylight for most of North America. However, regions of eastern Canada will see the end of the total phases just as the moon rises. Asia and Africa fair better and are treated to excellent views of this eclipse, occurring two weeks after a partial eclipse of the sun that was visible throughout North America on December 25.

A rather odd sight will greet observers near the East Coast: When the full moon rises, a large chunk will be missing from its lower right. It's a perfect opportunity to snap unusual photos of the moon above the southeastern horizon just as the last of the sun's rays paints the foreground gold.

Aside from the eclipse, this is one of the brightest full moons possible. During December 1999 there was a lot of hype that it was the "brightest in a century." But this month's full moon is brighter, resulting from the fact that the moon now lies closer to Earth.

For the second January in a row, some North Americans will witness a lunar eclipse. Alister Ling



Comets and Asteroids

Psyche Buzzes the Bull

A threat to our very existence, some asteroids come whizzing past Earth with scarcely any advance notice. Fortunately so far, the large ones that could cause our extinction have all missed, such as the one named 2000 QW7 discovered last August. It's a treat to see these near-Earth asteroids move against the starry background in mere seconds. On the other hand, the vast majority of asteroids, such as main belt citizen 16 Psyche, orbit at a more leisurely pace, comfortably in the distance. Psyche spends all month a couple degrees from the ruddy star Aldebaran, the luminary of Taurus the Bull. This busy region of sky is also playing host to Jupiter and Saturn, as it has been for the past couple months (see page 75).

At 160 miles (260 km) across, Psyche is a modestly large chunk of rock near the bottom of the "Top 10" on an observer's list. It presents a nice poten-

tial target for a space mission flyby. It has an average reflectivity, about twice that of our moon, and this month shines near 10th magnitude.

To find 16 Psyche, hop three lunar diameters (1.5°) northwest of Aldebaran, about halfway up to Epsilon, the other eye of the Bull. If you don't have access to deep-sky charting software to separate Psyche from the background starfields, then use the "tried and true" movement method to identify it: Make a sketch of the starfield going a bit fainter than the chart. On the next available clear night, go back to see which "star" has moved. It takes about six nights for Psyche to travel the apparent size of the moon. This method of sketching is good for finding not just asteroids but also comets and even Pluto or Neptune.

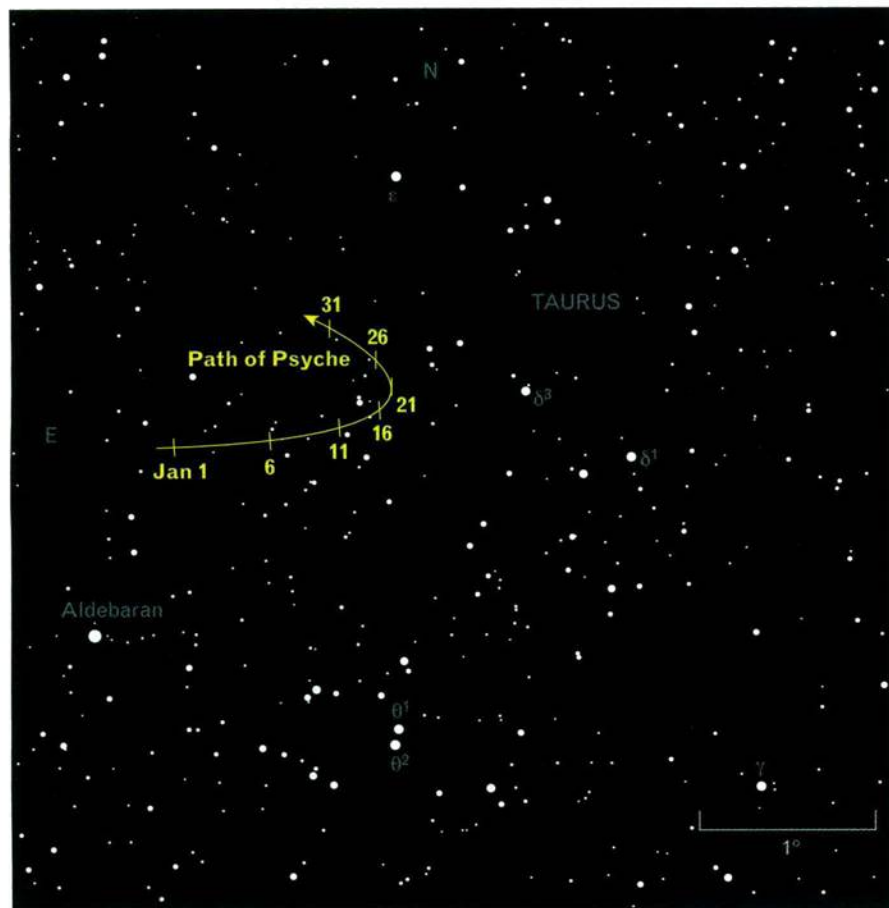
In the 19th century, asteroids were discovered visually, a painstaking process. Asteroid 1 Ceres broke astro-

nomical news in 1801, but it took more than 50 years to nab Psyche, just 16 down on the list. A. de Gasparis discovered it in 1852. Today's astronomers use high-tech light-sensitive equipment, called photometers, to study how its brightness changes as it spins. It rotates every 4.2 hours, and the pros have even figured out where its north pole points.

Nowadays, well-equipped amateur astronomers can discover new asteroids practically on a nightly basis while making routine positional measurements of known asteroids.

In mythology, Psyche was married to none other than Cupid, the God of Love, but, in a classic case of tragedy, was not permitted to look upon him. Temptation, like in all good fairytales, was too hard to resist, and this precipitated her downfall from the anger of Venus. Psyche endured severe tests to prove her love to Cupid, whereupon she was made a Goddess. They lived happily ever after on Olympus.

Psyche is just one of thousands of identified main-belt asteroids. The so-called Asteroid Belt lies between Mars and Jupiter, from 1.7 to 4.0 AU. But well-defined gaps exist within the orbits of the main-belt asteroids. The orbital period of asteroids that would lie within these gaps correspond to simple fractions of Jupiter's orbital period. Asteroids that once orbited with these periods were probably perturbed into different orbits due to regular passes with Jupiter's gravitational pull. The perturbations would fling the asteroids into orbits that would then cross Mars and Earth, probably causing many collisions early in the solar system's history. This phenomenon was first explained by Daniel Kirkwood in 1857; therefore the voids in the Asteroid Belt are named Kirkwood Gaps. (In a similar way, Kirkwood also explained the Cassini and Encke Divisions of Saturn's rings by orbital resonances.) **A**



Martin Ratcliffe is Director of Theaters at the Exploration Place in Wichita, Kansas. Alister Ling is a meteorologist working for Environment Canada in Alberta.

The definitive website for astronomy

We invite you to visit
Astronomy.com — the newly
redesigned and enhanced
website from the publishers
of *Astronomy Magazine*.

At the heart of *Astronomy.com*
are eight core content areas:
News, Feature Stories,
Observing, Image Gallery,
Educational Resources
(Parents and Teachers), Kids'
Corner, Getting Started, and
Shopping. These eight sections
offer visitors a wide variety of
information in an easy to
navigate, highly dynamic
and interactive format.

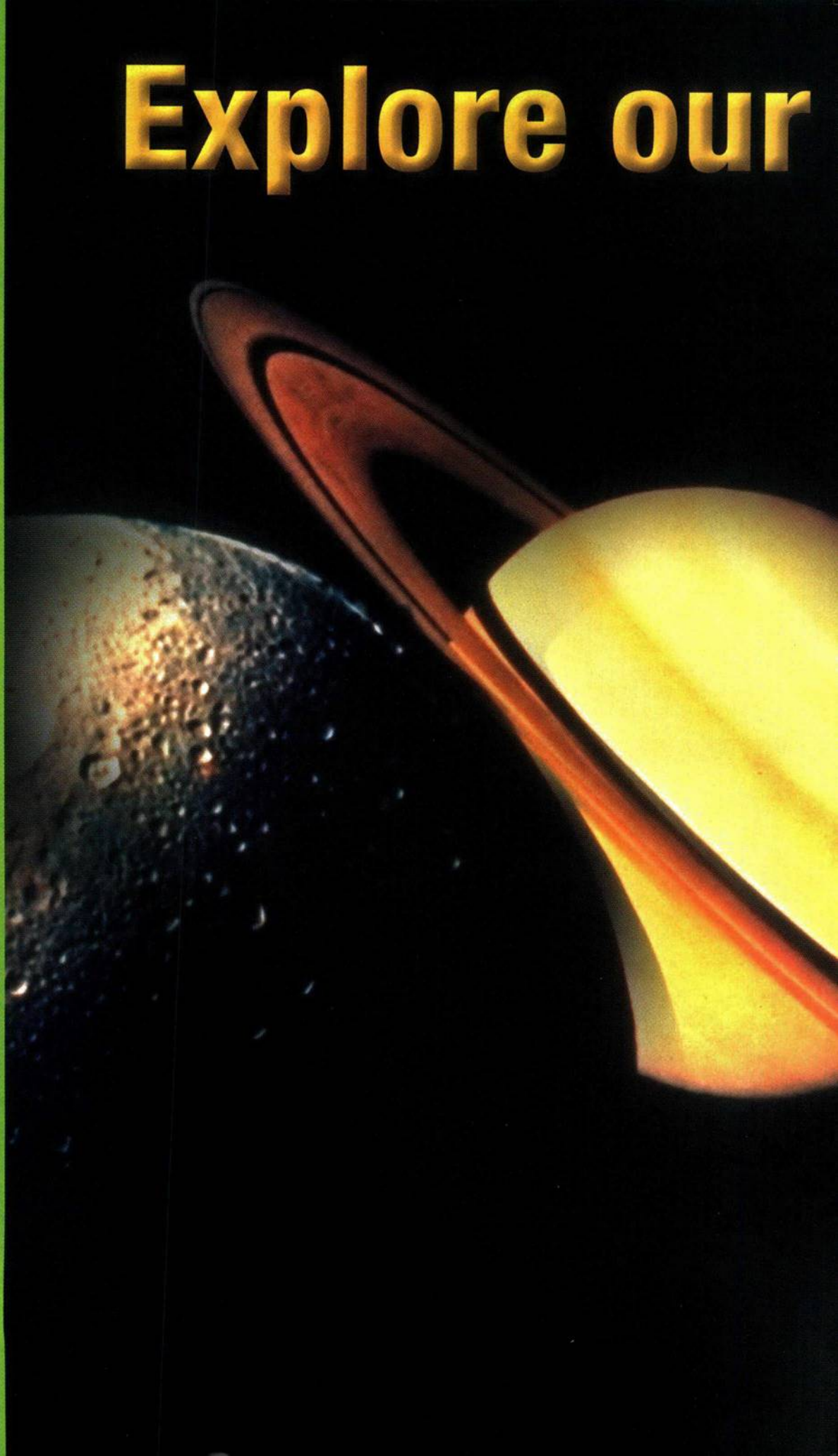
Areas such as News are
updated daily — more
frequently when warranted.
Tonight's Sky showcases
objects currently visible, while
our interactive star chart
allows visitors to create a
personalized view from any
position on Earth at any time
of day or date. The redesigned
site also offers parents and
teachers activities to help feed
the interest of their charges.

Throughout history, astronomy
has tempted the inquisitive
nature of humans. The staff of
Astronomy.com intends to
foster that curiosity by produc-
ing the definitive website of
astronomy. We hope each of
our visitors learns something
new every single day.

Andrea Gianopoulos

Andrea Gianopoulos, Editor

Explore our



stellar new site!

- Delve into the latest news and feature stories — you'll find something for every level of interest.
- A convenient one-stop shopping service offers the widest selection of astronomy products on one site.
- Discover the telescope that best suits your needs with our interactive guide.
- Customizable star charts — the sky from your backyard or vacation destination
- Scheduled live chats with scientists
- Club calendars and message boards
- PLUS — Astronomy Bulletin Service (ABS), customizable weather, a complete guide to sky events and star parties, resources for parents and teachers, an extensive photo gallery, and more!



Astronomy.com

Cassiopeia



*Several nearby galaxies
join the Milky Way
marvels that adorn this
queen's realm.*

by Tom Polakis

As the cold winds of January blow, few vistas seem so incongruous as the northwestern sky. There, slowly sinking from view in the early evening, hangs the summer constellation Cygnus and its luminary Deneb. If you raise your sight from Cygnus two-thirds of the way to the zenith, you'll come to Cassiopeia the Queen, the standout constellation of the autumn and early winter Milky Way.

Five 2nd- and 3rd-magnitude stars make up the main body of Cassiopeia. Together these five form the unmistakable shape of the letter M or W — the correct letter depending on the time of night and time of year. Although the Milky Way backdrop of Cassiopeia lacks the impact of the summer star clouds, many fine clusters and nebulae call it home. And the relatively sparse Milky Way lets through the light of a few background galaxies.

We begin our tour of Cassiopeia's telescopic treats in the western regions of the constellation. If you draw a line from Alpha (α) through Beta (β) Cassiopeiae and extend it an equal distance, you'll land on the bright open cluster **M52**. At a distance of 4,600 light-years, the cluster escapes naked-eye detection but shows up well in an 8x50mm finderscope. An 8-inch telescope shows 75 stars ranging from 9th to 12th magnitude. The cluster appears well defined against the starry background, particularly on its western edge. A prominent clump of six stars lies on the eastern edge.

Pan just half a degree southwest of M52 to find **NGC 7635**, the Bubble Nebula. The name stems from a spherical region of gas that glows from the energetic radiation emitted by an 8th-

magnitude star located near the nebula's brightest portion. The shell spans 10 light-years and lies 11,000 light-years from Earth. An 8-inch telescope at a dark site barely shows the Bubble Nebula as an arc 3' long and 1' wide surrounding the bright star. A broad-band nebula filter significantly improves the view. A 16-inch scope reveals a fainter haze to the north of the bright arc and separated from it by a dark lane.

Sweep 4.5° east of the Bubble and you'll arrive at the small open cluster **NGC 7790**. High magnification brings out a couple dozen 11th-magnitude stars in an area 5' by 3' across. Despite a confusing array of field stars, the cluster stands out nicely. Another pretty cluster lies 16' to the northwest. **NGC 7788** appears as a tight grouping of a dozen or so stars fainter than those in **NGC 7790**.

One of the sky's more spectacular open clusters lies 4.5° south of **NGC 7790**. **NGC 7789** contains hundreds of stars spread across a 20' field. An 8-inch telescope shows more than a hundred members and the number just keeps increasing with aperture. The sheer number of similarly bright stars creates a visual impression that dark lanes permeate the cluster. One such lane produces a tiny island of stars near the center while another isolates a small patch of five stars on the western edge. Professional astronomers have cataloged 15,000 members in this ancient cluster. Estimates place its age at 1.6 billion years and its distance at 9,000 light-years.

Pan 1.5° east of Beta Cassiopeiae to home in on the Local Group galaxy **IC 10**. Astronomers didn't recognize this diffuse object as a galaxy until 1935.

And no wonder — even through a modern backyard telescope it appears as no more than an ill-defined haze measuring 3' by 2' in a very starry setting. IC 10 lies roughly 2 million light-years from Earth, about the same as the Andromeda Galaxy (M31). Yet it appears far less impressive because it is intrinsically smaller and fainter than M31 and because the Milky Way dims the galaxy's light by nearly four magnitudes. You'll need an 8-inch telescope to reliably see IC 10. In a 20-inch scope at high magnification from a dark Arizona site, I noticed a clumpy structure that represents the numerous star-forming regions in the galaxy.

Two more faint Local Group galaxies lie in southern Cassiopeia, near the constellation's border with Andromeda. Not surprisingly NGC 147 and NGC 185 are companions to the Andromeda Galaxy. These dwarf ellipticals appear brighter and larger than IC 10, making them only a little easier to see. NGC 147 features a misty, oval halo 6' by 4' with a slight brightening toward the center. Just 1° to its east lies the brighter NGC 185. A moderate-aperture Newtonian reveals a 5' by 3' halo with a broadly concentrated and much brighter core.

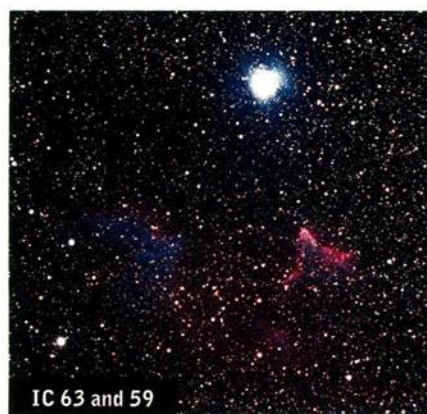
Returning to our own galaxy, a pair of reflection nebulae appear in the same field with Gamma (γ) Cassiopeiae. Both IC 59 and IC 63 lie about 25' from the 2nd-magnitude star, forming an equilateral triangle to the north and northeast of it. IC 63 is easier to see, appearing like a comet radiating away from Gamma Cas. If you spot this one, go after IC 59, a fainter smudge that appears 8' across and round in the eyepiece.

The emission nebula NGC 281 resides less than 2° east of Alpha Cassiopeiae. Photographs show the nebula has an intriguing shape, which led to its now dated nickname "The Pac Man Nebula." It measures 0.5° across and possesses a dark lane that divides the brighter from the dimmer portion. A nebula filter helps bring out the faint nebulosity. An 8th-magnitude star that forms the eye of the Pac Man shines through the brightest region of the nebula. This young, hot star provides most of the ultraviolet radiation that ionizes the nebula.

About one-third of the way between Alpha and Gamma Cassiopeiae lies the 2nd-magnitude double star Eta (η) Cassiopeiae. A small scope at 100x



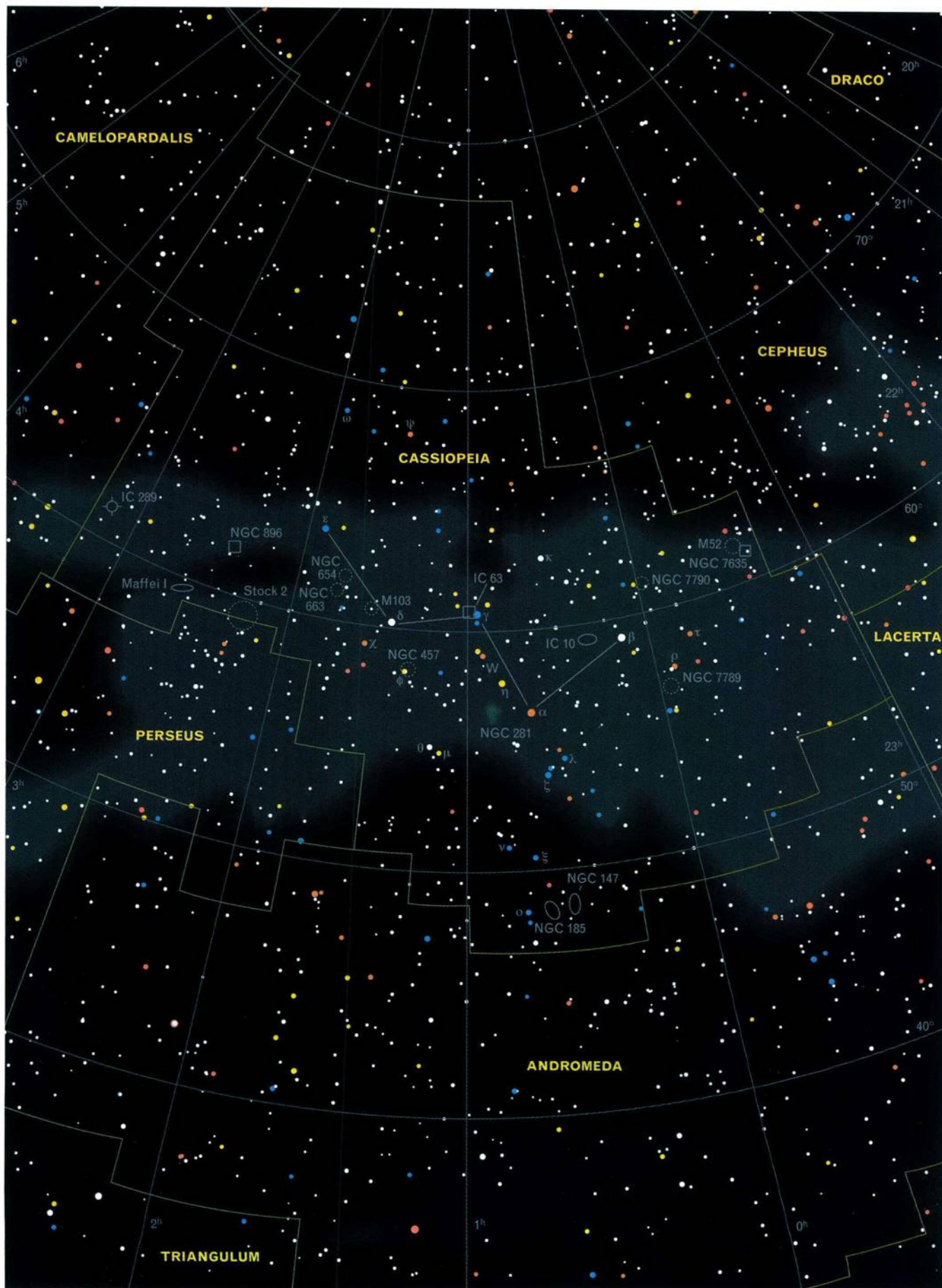
Bob and Janice Fera



George Greaney



James R. Foster



NGC 7635



easily splits the companion star, 12.9" to the northwest. The brighter component is a sunlike star and gives a good idea of what our sun would look like if viewed from a distance of 20 light-years. The system's velocity and proximity give it a high proper motion — it races across the sky at more than 1" per year.

Pan just 1° northeast of Eta and you'll come to the colorful carbon star **W Cassiopeiae**. Even a small scope will showcase this star's deep orange to reddish color. A Mira-type variable star, W Cas ranges from 9th to 12th magnitude and back again over a period slightly longer than 400 days.

Sweeping 3° east of W Cas brings the young open cluster **NGC 457** into view. The cluster contains several dozen stars brighter than 12th magnitude, but one stands out. Phi (φ) Cassiopeiae shines at 5th magnitude on the cluster's southeastern edge. Because NGC 457 lies 8,000 light-years from Earth, Phi Cas must be 50,000 times as luminous as the sun. A small scope does a fine job on this cluster, showing the two "wings" of stars that

Deep-Sky Objects in Cassiopeia

Object	R. A. (2000.0)	Dec.	Mag.	Size/Sep./Per.	Type	Notes
NGC 7635	23h20.7m	61°12'	—	15' by 8'	BN	Bubble
M52 (NGC 7654)	23h24.2m	61°35'	6.9	12'	OC	
NGC 7789	23h57.0m	56°44'	6.7	15'	OC	
NGC 7790	23h58.4m	61°13'	8.5	17'	OC	
IC 10	0h20.4m	59°18'	11.3	7.3' by 6.4'	Gal	IBm
NGC 147	0h33.2m	48°30'	9.5	15.0' by 9.4'	Gal	E5 pec
NGC 185	0h39.0m	48°20'	9.2	14.5' by 12.5'	Gal	E3 pec
Eta Cassiopeiae	0h49.1m	57°49'	3.4/7.5	12.9"	DbI	
NGC 281	0h52.8m	56°37'	—	35' by 30'	BN	Pac Man Nebula
W Cassiopeiae	0h54.9m	58°34'	8.9–12.5	406 days	Var	Carbon star
IC 63	0h59.5m	60°49'	—	10' by 3'	BN	with IC 59
NGC 457	1h19.1m	58°20'	6.4	13'	OC	
M103 (NGC 581)	1h33.2m	60°42'	7.4	6'	OC	
NGC 654	1h41.1m	61°53'	6.5	5'	OC	
NGC 663	1h46.0m	61°15'	7.1	16'	OC	
Stock 2	2h15.0m	59°16'	4.4	60'	OC	
NGC 896	2h24.8m	61°54'	—	20' by 20'	BN	
Maffei I	2h36.3m	59°39'	11.4	0.6' by 0.5'	Gal	S0 pec
IC 289	3h10.3m	61°19'	13.3	34"	PN	

Object: Designation in Messier, NGC, or other catalog. **R.A. (2000.0) and Dec.:** Right ascension and declination in epoch 2000.0 coordinates. **Mag.:** Visual magnitude. **Size/Sep./Per.:** Size in arcminutes or arcseconds, separation in arcseconds, or period in days. **Notes:** Hubble type for galaxies.



The Queen

*"Black, but such as in esteem
Prince Memnon's sister might beseem.
Or that starred Ethiop queen that strove
To set her beauty's praise above
The sea-nymphs, and their powers offended."*

Penseroso
John Milton (1608–1674)

Cassiopeia the Queen plays a key role in one of the grandest Greek legends, one that encompasses five constellations on prominent display during evenings in late autumn and early winter. Cassiopeia and her husband, Cepheus the King, are the only husband-and-wife couple enshrined among the stars.

It seems that Cassiopeia was a rather vain woman who often boasted that she was more beautiful than the sea nymphs. Now the sea nymphs — daughters of the sea god Nereus and attendants to the chief deity of the sea, Poseidon — had some pride of their own and didn't appreciate being disparaged. And they hatched a plot to get even.

They asked Poseidon to punish the queen and he agreed, sending a great sea monster (our constellation Cetus) to ravage the kingdom. Desperate to stop the attacks, Cepheus asked an oracle what to do. The verdict: Chain their daughter Andromeda to a rock on the coast and sacrifice her to the sea monster.

Seeing the dire predicament, Perseus offered to save Andromeda if promised her hand in marriage. Cepheus agreed, and Perseus used the severed head of Medusa to do battle. With hair made of writhing snakes, Medusa was so hideous that anyone or anything that saw it turned to stone. Perseus showed the head to Cetus, killing the monster and winning the princess. — *Richard Talcott*

earn NGC 457 the names "The Owl" and "The Airplane." One wing radiates to the east of the cluster as a line of four bright stars while the western wing consists of two pairs of stars arranged in a long rectangle.

The second and last Messier object in the constellation lies just 1° east-northeast of Delta (δ) Cassiopeiae. The open cluster **M103** may not look spectacular but its 40 bright stars stand out well from the rich fields of the Milky Way. Cluster members range from 8th through 13th magnitude and group tightly in a triangle 5' across.

Continue another 1.7° along a line from Delta Cas through M103 and you'll arrive at an open cluster that managed to escape Charles Messier's notice. **NGC 663** has more than 20 stars brighter than 11th magnitude

spread across 12'. An 8-inch scope shows 30 stars brighter than the surrounding Milky Way fields while a 12-inch instrument brings the star count up to 50 and reveals a chain of brighter stars on the cluster's north-western side.

Back off to your lowest power and the smaller open cluster **NGC 654** should come into view to the north. The cluster contains 40 stars shining between 7th and 12th magnitude in a circle that spans 5'. Located approximately 8,000 light-years away, it appears well isolated from the surrounding field.

Some 6° southeast of Epsilon (ϵ) Cassiopeiae lies the nearby cluster **Stock 2**. The cluster's relative proximity — it's about 1,100 light-years from Earth — shows up most clearly in size, not brightness. Stock 2 spans a full degree and so looks best when viewed in a small telescope at a magnification less than 50x. Expect to see about 50 stars between 8th and 10th magnitude scattered loosely across a 1° field. Cut the magnification back to less than 15x and the famed Double Cluster in Perseus, which lies about 2° to the south, also comes into view.

Swing 3° north-northeast of Stock 2 to find the emission nebula **NGC 896**. To see this object at all, you'll need a moderate-aperture telescope and a nebula filter. Although the nebula

photographs spectacularly, only the bright condensation on its western edge can be seen easily. Sweeping the region with a low-power eyepiece, however, reveals several fields awash in faint nebulosity.

Pan 3° southeast of NGC 896 and you'll find yourself traveling just beyond the realm of the Local Group of galaxies. **Maffei I** is the nearest large elliptical galaxy to Earth, located some 10 million light-years away. You'll need at least a 10-inch telescope to have much hope of spying this object, which appears as a uniform haze measuring 3' by 2' in the midst of a typically rich Cassiopeia star field. Astronomers think it belongs to a galaxy group headed by IC 342.

We close our west-to-east sweep of Cassiopeia with a bright planetary nebula near the constellation's border with Camelopardalis. **IC 289** presents a 30"-diameter circular disk with a diffuse edge. Its high surface brightness permits a close look, which hints at a pair of symmetrical lobes that become apparent through large apertures. The central star glows too dimly to spot in a backyard telescope. **A**

Tom Polakis is an aerospace engineer living in Tempe, Arizona. His favorite astronomical pursuits are deep-sky observing and photography.



Michael Strecker

NGC 457

Specialists in Video and CCD imaging

www.astrovid.com



Astrovid 2000

· Easy to use Real-time Video System
· No computer required · Perfect for schools and planetariums · LCD Systems available



CCD Imaging Accessories

· Unique combo flip mirror filter holder
· Large format motorized filter wheel
· Tri-color dichroic and CMY filter sets



Starlight Xpress

· Innovative compact design · Low noise
· High blue sensitivity · Models include unique "one-shot color" CCD

Call us toll free at: 1.888.799.0107

or visit our website at: www.astrovid.com for additional information and for many more unique products.

Adirondack Video Astronomy

26 Graves Street, Glens Falls, NY 12801 USA

Info line +1 518 812 0025 Fax +1 518 745 4114

www.astrovid.com



adirondackVIDEOastronomy



Since 1947

LET'S UNLOCK THE MYSTERY OF THE UNIVERSE!

What our customers say...

"Thank you for excellent advice and help"

M. Escondido, CA

"Your employees have a genuine interest in the hobby"

M.S. Eagle, CO

We have the most knowledgeable, friendly, bend-over-backwards, knock-themselves-out-for-you staff anywhere in the universe

www.optcorp.com

On Line Catalog



ETX-125EC

ETX-90EC

plus accessories

Meade
THE LEADER'S EDGE

SBIG
ASTRONOMICAL INSTRUMENTS

The Leader in CCD Imaging



Meade
THE LEADER'S EDGE

7", 8",
10" & 12"
LX200's
in stock

Computer
Robotic
Telescope



TeleVue
Visionary



TeleVue
specialists here
to help you!

NexStar[™] 5

Computer
Robotic Telescope
In Stock!



CELESTRON

We're not just a phone number—we're a real store!

JMI • KENDRICK
LOSMANDY
LUMICON
OPTEC • ORION
1000 OAKS
SBIG • DISCOVERY

**OCEANSIDE
PHOTO & TELESCOPE**

1024 MISSION AVE
OCEANSIDE CA 92054
OPEN 7 DAYS

email: opt@optcorp.com

1-800-338-9638

NEW

ROBO-DOME[™]



50" tall ROBO-DOME, with Thanh

- All-robotic observatory
- Big enough for a telescope, but not a person
- Fully Assembled
- All Fiberglass
- Very Affordable: \$3200

Visit our Web Site!

We manufacture 6, 10 and 15 ft.
**HOME-DOME & PRO-DOME
OBSERVATORIES.**

Technical Innovations, Inc.

22500 Old Hundred Rd.

Barnesville, MD 20838

Ph: 301-972-8040

Fax: 301-349-2441

www.homedome.com

FREE Brochure

Visit The Astronomy Shoppe

(at our store, online, or over the phone)



You'll be talking to an amateur astronomer when you do. We carry such brands as Meade, Celestron, Orion, TeleVue, and Takahashi. We also carry a full range of accessories including eyepieces, photo adapters, mounts, binoculars, spotting scopes, and a whole lot more.

The Astronomy Shoppe

www.darkskyinc.com

1-888-999-6396 (Toll Free)

1-602-971-3170 (Arizona)

3202 E. Greenway, #1615,

Phoenix, AZ 85032

E-mail: astroshop@earthlink.net

MasterCard and Visa Accepted

ask Astro

Pulsating Polaris, Astronomy Lingo, Hubble Space Telescope,
Bino Viewing



Bright Cepheid cousins of
Polaris in NGC 206 reveal
how far away M31 really is.

B.J. Mochejska/FLWO/MDM

I understand that Polaris has stopped flickering or pulsating. Is this true? — Judith Virta, Sault Ste. Marie, Ontario, Canada

Polaris, our “constant” north star, is actually variable, cyclically changing by a slightly perceptible 0.03 magnitude every 3.97 days. What’s more, it’s the sky’s brightest Cepheid variable star.

Cepheids, epitomized by Delta Cephei, Zeta Geminorum, and Eta Aquilae, are all luminous, warm (spectral class F and G) supergiants that have lost their sense of balance and pulsate with clockwork regularity, typically changing by a magnitude or so over periods of a few days.

Cepheids are fundamentally important to astronomy, as their pulsation periods are tightly linked to their average luminosity. They are so brilliant

that they are easily recognized in other galaxies. Measures of periods give true brightness. Comparison with apparent brightness then yields distances, allowing us to step across the universe.

Polaris has decided to be different, and not just because of its ultrasmall variations. Unlike other Cepheids,

its peak-to-peak variations have declined over the last century from a noticeable 0.12 magnitudes to their present minuscule level. For a while, astronomers thought that the variations might stop and that the star might be evolving out of the temperature and luminosity conditions required for a star to be a Cepheid. That exciting possibility of evolution before our eyes, however, does not seem to be the case. Not only has the decline in variation ceased, Polaris is not near the limits of Cepheid conditions.

What appears to be happening is perhaps even more interesting. Just as musical instruments have “fundamental” tones that give them their basic pitches, they also vibrate in higher-frequency overtones that give them their timbres. Stars can do the same thing. Comparison with other Cepheids shows that Polaris is pulsating with its first overtone rather than its natural fundamental period. No one quite knows why the variations are so small or why they have decreased. The star

may be in the process of evolving into its fundamental period of 5.68 days to become a “normal” Cepheid with a greater variation. All we can do is wait it out — perhaps for a long time. — Jim Kaler, University of Illinois. He describes a different star each week on his website at www.astro.uiuc.edu/~kaler/sow/sow.html.

Could you please explain the difference between “apparent visual magnitude” and “absolute visual magnitude”? — Anita Waters, Visalia, California

Apparent visual magnitude measures how bright a celestial object appears to the human eye. It is based on a system devised by the ancient Greek astronomer Hipparchus. In this system, the lower the magnitude value, the brighter the object. Thus, an object with an apparent magnitude of -4 , such as the planet Venus, appears brighter than an object with an apparent magnitude of $+4$, such as a moderately bright naked-eye star. The magnitude scale is logarithmic, where a five-magnitude difference represents a factor of 100 in brightness.

Absolute visual magnitude measures how bright an object would appear to be if it were 10 parsecs away (1 parsec equals 3.26 light-years). This is a measure of a star’s intrinsic brightness. And by comparing a star’s apparent magnitude (apparent brightness) with its absolute magnitude (intrinsic brightness), astronomers can determine a star’s distance. — Edward Gleason, Southworth Planetarium, Portland, Maine

It seems incredible that a huge orbiting telescope such as the Hubble Space Telescope can remain pinpointed on a star or galaxy for extended periods of time. How is this done? — Irving Morrisett, Green Valley, Arizona

It is pretty tricky to keep the Hubble Space Telescope (HST) locked on target. After all, unlike telescopes on Earth, HST can’t use the ground as leverage to keep things tracking. So, instead of using the ground, HST uses a series of gyroscopes. When you push on

a gyroscope, it pushes back. If you have a group of them, pointed in different directions, they can maintain their relative positions astonishingly well. There are six gyroscopes on board HST, and four are used to maneuver the scope.

The gyroscopes can be coaxed to move HST over large scales, from target to target (called “slewing”). These moves are relatively slow — it would take about an hour to make a full circle in the sky. Once HST is near the target, it uses instruments on board called the Fine Guidance Sensors (FGS) to pick out bright stars near the target object. Using some sophisticated physics, the FGS keep very close watch on these stars. If the telescope starts to drift, the stars appear to move, and the FGS tell HST to compensate. The FGS can lock onto these “guide stars” with incredible accuracy — in “Fine Lock” mode, they keep the telescope from moving more than about seven one-thousandths of an arcsecond, or about one-millionth of a degree. That’s one reason Hubble can return such fantastic images from space; it can stay pointed with an accu-

The Hubble Space Telescope routinely displays its amazing ability to stay on target. NASA

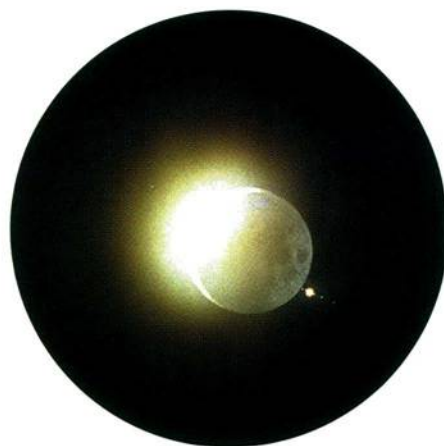


racy that would make any marksman jealous. — *Phil Plait, webmaster, www.badastronomy.com. (Special thanks to Ed Nelan of the Space Telescope Science Institute.)*

Can binoculars be used for planetary astronomy? If so, are the principal moons of Jupiter visible in binoculars? How about the phases of Venus, anything on Mars, or the rings of Saturn? What power and/or aperture would be best (in a city)? — *George Devore, Fort Myers, Florida*

If you intend to see much of anything at all on the moon and planets, you’re probably better off buying a telescope. Nevertheless, there are some satisfying celestial views to be obtained through a good set of binoculars.

A 7x50 pair of binoculars (seven power, with twin 50mm-diameter main lenses) easily reveals Jupiter’s four largest moons and their relative positions around the planet, which change from evening to evening. These venerable binos will even expose



A set of high-power binoculars will afford nice views of the moon and Jupiter. Jacques Guertin

Saturn’s “ears” (don’t expect to see rings), the phases of Venus and Mercury, as well as large craters on the moon. Mars and Uranus usually display themselves as steady red and green disks, respectively.

But if you do insist on using binos for planetary astronomy, pick up a higher-power pair, perhaps between 10 and 15 power, maybe more, and be prepared to mount them on a tripod. At about 10 power, you will likely begin to reach the limit of your ability to hold a pair of binoculars steady enough to yield a clear view.

If you’d rather avoid the extra space and setup of tripods, consider an image-stabilized binocular. Unlike anything on the market, these employ adaptive optics technology to steady your view. Expect to spend some money, though; their street price is around \$1,400.

At 15 power or more, you should start to see banding on Jupiter. Saturn’s rings might even begin to resolve when the planet is around opposition and closest to Earth. As Venus approaches passage between Earth and the sun over the next few months, try looking for a nightside fringed with atmospheric glow. In 2003, when Mars is at its closest in 15 years, 15-power binos might even show dark markings or a polar cap. — *John Shibley, contributing editor* **A**

CONTACT INFO

Send your questions via e-mail to: askastro@astronomy.com; or write to: Ask Astro, P.O. Box 1612, Waukesha, WI 53187. Please tell us your full name and where you live.

TOLL FREE FAX
800-TO-FOCUS
OVERSEAS FAX
718-437-8811

4419-21 13TH AVE.
BROOKLYN, N.Y. 11219

888-221-0828

N.Y. STATE & OVERSEAS
718-437-8810
E-MAIL ADDRESS
orders@focuscamera.com

MEADE ADVANCED PRODUCTS

MAKSUTOV-CASSEGRAINS

ETX SCOPES

Exquisite, Diffraction-Limited Imaging in an advanced, ultra portable telescope system!

ETX-90EC Includes:
w/Dual-Axis Drive,
8x21 Erect-Image Viewfinder
& 26mm Plossl



ETX-125EC Includes:
Dual-Axis Drive,
8x25 Right-Angle Viewfinder
& 26mm Plossl

Optional #497 Autostar
controller with
GO TO capability \$149

NEW! ETX 60 AT 60mm (2.4"), 350mm f/5.8	\$299
NEW! ETX 70 AT 70mm (2.8"), 350mm f/5	\$349
ETX 90EC 1250mm f/13.8	\$595
ETX 125EC 1900mm f/15	\$895
LX-50 7" f/15 w/Std Equatorial Wedge	\$1,795
LX-200 7" f/15 w/Heavy Duty Fork Mount	\$2,795
#883 Deluxe ETX Field Tripod (90/125)	\$199.00
#64 Photo Adapter (90/125)	\$34.95
#825 8x25 Right-Angle Viewfinder (90)	\$49.95
#880 Equatorial Table Tripod (90)	\$29.95
#881 Equatorial Table Tripod (125)	\$59.95
#932 45° Erecting Prism (90/125)	\$49.95
#1244 Electric Focuser (90)	\$119.95
#1247 Electric Focuser (125)	\$119.95
#773, #774, #775 Hard Case for ETX	CALL

SCHMIDT-CASSEGRAINS

In virtually every country in the world where serious telescopes are sold, more Meade LX-200's are sold than all competing models combined.

Standard-equipment includes:
• Superb optics
• Automatic GO TO capability
• LX-200 High-Precision Pointing
• Permanently-Programmable Smart Drive
• 9-Speed Dual-Axis Electronics
• Field operation



NEW! LX-90 8" f/10	\$1,695
LX-10 8" w/Hand Controller	\$995
LX-50 8" f/10	\$1,395
LX-50 10" f/10	\$1,695
LX-50 10" f/10 w/Super Wedge	\$1,895
LXD 300 SERIES 203 8" f/10	\$795
LXD 500 SERIES 203 8" f/10	\$895
LX-200 8"	\$2,295
LX-200 10"	\$2,695
LX-200 12"	\$3,995
LX-200 16"	CALL
LX-200SC 12" f/2.2 Schmidt-Camera	CALL
Magellan I #2014 f/LX-10	\$375
Magellan II #2024 f/LX-50	\$495

STARFINDERS



Dobsonian Deluxe Package Add \$495



SPECIAL EYEPIECE OFFER!
At time you order any Meade Equatorial, get a 9mm Series 4000 Plossl for only \$29.95!

	Dobsonian	Equatorial
6" f/8 w/26mm Plossl	\$349 ²⁵	\$649 ²⁵
8" f/6 w/26mm Plossl	\$449 ²⁵	\$749 ²⁵
10" f/4.5 w/26mm Plossl	\$599 ²⁵	\$879 ²⁵
12" f/4.8 w/26mm Plossl	\$895 ²⁵	-
16" f/4.5 w/26mm Plossl	\$1,195	\$2,695
Magellan I #2010 f/Dobsonians	\$295	
Magellan I #2011 f/Equatorial 6", 8", 10"	\$295	
Magellan I #2012 f/Equatorial 16"	\$295	
Magellan II #2018 f/Equatorial 6", 8", 10"	\$495	
Magellan II #2019 f/Equatorial 16"	\$595	

BINOCULARS & SPOTTING SCOPES

CELESTRON

BLOWOUT!

8-32x50 Zoom . . . \$114²⁵

9x36 Ultima	CALL	20x80 Giant	\$368.95
8x32 Ultima	\$188.95	10x50 Regal	CALL
8x56 Ultima	\$268.95	8x40 Pro	\$114.95

MEADE

8x25 Safari Pro	\$180	10x25 Safari Pro	\$200
7x36 WA Safari Pro	\$170	8x42 WA Safari Pro	\$180
10x42 Safari Pro	\$190	10x50 WA Safari Pro	\$200
7x42 WA Rainforest Pro	\$480	8x56 Rainforest Pro	\$500

Nikon SPORT OPTICS

You'll Never See Things Quite The Same Again!

7x35 E	245	8x30 E	257	10x70	\$1048.95
8x32 E Superior	CALL	7x50 Prostar	CALL		\$721.95
10x42 E Superior	CALL	10x40 Lookout IV	CALL		\$102.50
12x50 E Superior	CALL	10-22x50 Scoutmaster XL	135		

SPOTTING SCOPES

Fieldscope (60mm)	\$347.95
Fieldscope 60 ED II	\$574.95
Fieldscope 78 ED	\$1,229.99
60 ED II Angled	\$634.95
78 ED Angled	\$1,299.99



SPOTTING SCOPES

AP0 TELEVID 77mm

Ask About Leica's Passport Protection

Kowa

77mm SERIES SPOTTING SCOPES

TSN-2	\$379.95	TSN-3	\$799.95
-------	----------	-------	----------

TSN-4 . . . \$649²⁵

82mm SERIES WATERPROOF SPOTTING SCOPES	
TSN-821 Angled	CALL
TSN-822 Straight	\$364.95
TSN-823 Angled	\$814.95
TSN-824 Straight	CALL

Check Out Our Special Package Pricing on 820 Series Spotting scopes
Package includes: Scope, 20-60x, Case & Tripod.

ZEISS Canon

Special 15x60	\$1,849	IMAGE STABILIZERS	\$50
20x60 Image Stabilizer	CALL	10x30 • 12x36 • 15x45	Rebate!
Spotting Scopes	CALL	15x50 AW • 18x50 AW	

FUJINON

SPECIAL! 7x50 FMTRC-SX w/Compass	\$499.95
8x30 FMT-RSX	CALL
10x70 FMT-SX w/Case	CALL
7x50 FMT-SX w/Case	CALL
16x70 FMT-SX w/Case	CALL
Super 80 Scopes w/Zoom & Case	CALL

C90 Multicoated Spotter Outfit

With Free T-Mount!



BAUSCH & LOMB BUSHNELL

Discoverer 15-60x	\$176.95
Discoverer T-Mount	\$11.95
Spacemaster	\$149.95
Spacemaster Armored	\$163.95
Spacemaster Zoom Black Armored	\$226.95
All Kits Include: 15-45x Eyepiece & Case or Pouch	
SWAROVSKI OPTIK	
SPOTTING SCOPES	
AT-80 • ST-80	
AT-80 HD Angled	
ST-80 HD Straight	

PICTOR CCD IMAGERS

416-XTE & 1616-XTE



For the beginner, or for the most advanced observer, the real CCD revolution is here!

201-XT Autoguider/Imager	\$395
208-XT Autoguider/Imager	\$495
216-XT Autoguider/Imager	\$695
416-XTE Autoguider/Imager	\$1,995
1616-XTE Autoguider/Imager	\$6,495
Off Axis Guider (OAG)	\$89.95
616 Color Filter System f/16, 1616-XT	\$695
616A Color Filter System f/216	\$695
520 Electronic Relay f/201, 208, 216, 416, 1616	\$94.95
541 AC Adapter f/201, 208, 216	\$36.95
542 AC Adapter f/416, 1616	\$94.95

EYEPIECES

MODIFIED APOCHROMATIC	
9, 12, 25, 40mm 1.25"	\$37.95
9, 12, 25, 40mm .96"	\$29.95
POSSL SERIES 3000	
5, 6.7, 9.5, 16, 25mm 1.25" 40mm 1.25"	\$79.95
SUPER POSSL SERIES 4000	
6.4, 9.7, 12.4, 15, 20, 26mm 1.25"	\$79.95
32, 40mm 1.25"	\$99.95
56mm 2"	\$199.95
POSSL SERIES 4000 SUPER WIDE ANGLE	
13.8mm 1.25"	\$139.95
18mm 1.25"	\$149.95
24.5mm 1.25"	\$179.95
40mm 2"	\$299.95
POSSL SERIES 4000 ULTRA WIDE ANGLE	
4.7mm 1.25"	\$169.95
8.8mm 1.25"/2"	\$239.95
6.7mm 1.25"	\$199.95
14mm 1.25"/2"	\$299.95
ILLUMINATED RETICLE EYEPIECE SYSTEMS	
	Wireless
Plossl 9mm 1.25"	\$149.95
MA 12mm 1.25"	\$99.95
MA 12mm Astrometric 1.25"	\$79.95
Plossl 25mm CCD Framing Ocular 1.25"	\$129.95
BARLOWS	
#122 2x Telenegative 1.25"	\$44.95
#126 2x Short Focus 1.25"	\$44.95
#127 2x-3x Variable 1.25"	\$56.95
#134 Achromatic .96"	\$44.95
#140 2x Apochromatic 1.25"	\$74.95

ED APO REFRACTORS

300 SERIES	
102 Achromatic 4" f/9	\$595
500 SERIES	
102 Apochromatic 4" f/9	\$1,649
102 Achromatic 4" f/9	\$695
102ED 4" f/9 w/Mount, Tripod & Acc.	\$2,795
127ED 5" f/9 w/Mount, Tripod & Acc.	\$3,295
152ED 6" f/9 w/Mount, Tripod & Acc.	\$4,995
178ED 7" f/9 w/Mount, Tripod & Acc.	\$5,995

Optical Tube Only	CALL
#1207 Electric Focuser	\$144.95
#1664 Electronic Drive	\$349
#1697 Computer Drive System	\$749
#1702 Dual Axis Drive System	\$195
#1812 Electronic DC Adapter	\$89.95

ACCESSORIES

#62 T-Adapter f/SCT	\$26.95	Off Axis Guider	\$79.95
#931 45° Hybrid Erect Prism 43	\$129.95	f/6.3 Focal Reducer	\$129.95
Basic Tele-Extender	\$29.95	#1205 Focuser	CALL
Camera Adapter 1.25"	\$29.95	#1206 Focuser	CALL
Camera Adapter .96"	\$27.95	6x30 Viewfinder	CALL
Variable Tele-Extender	\$39.95	8x50 Viewfinder	CALL
Dew Shield & Dust Cover	CALL	#607 25° Cigarette Adpt/25	\$39.95
Piggyback Bracket f/SCT	CALL	55 Manual DEC Control	\$75
Variable Projection Camera Adapter 1.25"	\$39.95		
#927 45° Erect Image Diagonal Prism .96"	\$42.95		
#928 45° Erect Image Diagonal Prism 1.25"	\$42.95		
#929, #930 2" Mirror Diag. w/Eyepiece Holder f/1.25"	\$99.95		
Tube Balance Weight System f/All SCT	CALL		
#531 Motor Drive w/Auto Tracking f/4500 Newtonian	\$149		
Interface Cable f/LX-200	\$25		
EPOCH 2000sk Sky Software 3.5" Disks	\$179		
EPOCH 2000sk Sky Software CD	\$179		
EPOCH 2000p Software 3.5" Disks	\$199		

FILTERS

#905 Variable Polarizer 1.25"	\$49.95	4 Piece Set 1.25"	\$49.95
Moan Filter ND96 1.25"	\$16.95	Skylight/Dust Seal	\$44.95
Individual Filters	\$14.95		
* Nebular	\$99.95	* Oxygen III	\$99.95
* #908 1.25"	\$99.95	* Broadband	\$99.95
* #910 2"	\$159.95	* Narrowband	\$129.95
* #911 Rear Cell	\$149.95		

DIGITAL ELECTRONIC SERIES

The Most Important Advancement in Beginning and Intermediate Telescopes in 100 Years!



- Object tracking
- Altazimuth mountings
- Electronic controller (EC)
- Autostar computer controller
- Meade StarNavigator software

ACHROMATIC REFRACTORS

DS-60 60mm (2.4"), 700mm f/11.8	\$199
DS-70 70mm (2.8"), 700mm f/10	\$249
DS-80EC 80mm (3.1"), 900mm f/11.3	\$449
DS-90EC 90mm (3.5"), 1000mm f/11.1	\$499

NEWTONIAN REFLECTORS

DS-114EC 114mm (4.5"), 910mm f/8	\$399
DS-127EC 127mm (5"), 1020mm f/8	\$499
Optional Autostar Controller	\$99 ²⁵

SPECIALS!

Bausch & Lomb

2x Barlow
1.25" (#631016) . . . \$34²⁵

Harbormaster Telescope

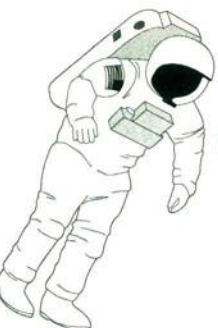
- Individually Numbered
- Hand Finished Legs
- Brass Tube

MEADE

2045s 4" Spotting Scope . . . \$409²⁵

CELESTRON

C90 Multi-Coated Spotting Scope (#81011) \$289²⁵



*America's
Largest Stocking
Authorized Astronomy
Dealer!*

We Ship Promptly!

888-221-0828

N.Y. STATE & OVERSEAS

718-437-8810

E-MAIL ADDRESS

orders@focuscamera.com

Order on The Web at:

www.focuscamera.com

CELESTRON

SCHMIDT-CASSEGRAINS

NEW! NexStar 8

There is no substitute for size. With Celestron's legendary 8" optics, now you can see deeper into space with the same ease as with the innovative NexStar 5. Images in the NexStar 8 are over two times brighter than with a 5" telescope.

With the touch of a button, the NexStar 8 will open door to planets, galaxies and nebulae that you have never experienced in your lifetime. Exquisite design, pinpoint computer control and stability come together in one dynamic package.



SCHMIDT-CASSEGRAINS

CELESTAR 8 COMPUTERIZED

Engineered for unsurpassed optical performance in an affordable, full featured Schmidt-Cassegrain telescope of large enough aperture to do serious deep-sky observing. This telescope is carefully crafted and manufactured in the USA for dependable quality of the highest caliber. It offers the lowest price ever for a Celestron fork mounted 8" telescope.



NexStar 8 8", 2032mm f/10	NEW!	\$1,899
NexStar 5 5", 1250mm f/10	NEW!	\$1,199
NexStar Tripod		\$175
G-3 3.5", 1000mm f/11		\$499
G-5 5", 1250mm f/10		\$699
G-8 8", 2032mm f/10		\$999
G 9 1/4 9 1/4", 2350mm f/10		\$1,299
CM-1100 11", 2800mm f/10		\$3,199

CELESTAR 8 8", 2032mm f/10	\$1,099
CELESTAR 8 Computerized	\$1,599
CELESTAR 8 Deluxe	\$1,699
CELESTAR 8 DLX Computerized	\$2,199
ULTIMA 2000 8" 2032mm f/10	
2032mm f/10 w/Go To System	\$2,699
CM-1400 14", 3910mm f/11	\$5,299

REFRACTORS

Firstscope 80 Series 80mm (3.1")	3 Models Avail.
Firstscope 60 Series 60mm (2.4")	4 Models Avail.
Firstscope 70 Series 70mm (2.8")	3 Models Avail.
Firstscope 60 Equatorial	\$109
Firstscope 80 Equatorial	\$349

NEW! NexStar 60 ST 60mm (2.4")	\$189
NEW! NexStar 80 HC 70mm (3.1")	\$299
C80-HD 80mm (3.1"), 900mm f/11	\$399
C102-AZ 102mm (4"), 1000mm f/10	\$399
C102-HD 102mm (4"), 1000mm f/10	\$499
CR-150-HD 150mm (6"), 1200mm f/8	NEW!

NEWTONIANS

NEW! NexStar 114 HC 114mm (4.5")	\$399
NEW! NexStar 114 GT w/Go To	\$499
Firstscope 76 Equatorial 76mm (3")	\$159
C114-HD 114mm (4.5"), 900mm f/8	\$399
C150-HD 150mm (6"), 1000mm f/7	\$499

STAR HOPPER DOBSONIANS	
4.5" \$239 6" \$399 8" \$499	

EYEPIECES & VIEWING ACCESSORIES

Diagonal, Prism Star	\$39.95	Diagonal, Mirror 2"	\$129.95
Diagonal, Erect Image 45°	\$39.95		
Diagonal, Erect Image 90°	\$49.95		
Plossl 1.25" 32, 40mm	\$49.95	Tele-Extender Dlx	\$48.95
Plossl 1.25" 6.3, 7.5, 10, 12.5, 17, 20, 26mm	\$39.95		
Ultima 1.25" 5, 7.5, 12.5, 18mm	\$74.95		
Ultima 1.25" 24, 30, 42mm	\$94.95		
Ultima 1.25" 35	\$99.95		
LV Series 1.25" 5, 6, 9, 10, 15mm	\$49.95		
LV Series 1.25" 2.5, 4, 12, 20, 25mm	\$109.95		
LV Series 1.25" 8-24mm Zoom	\$159.95		
BARLOWS			
2x 1.25"	\$39.95	2x .96"	\$19.95
2x 1.25" Ultima	\$62.95	2x .96" Dlx	\$44.95

FILTERS

4 Piece Filter Sets	\$49.95	Skylight Filter	\$44.95
Moon Filter 1.25"	\$6.95	Solar Filters	CALL
LPR Filter Model A 1.25"	\$59.95		
LPR Filter Model B f/Back Threads of SC's	\$84.95		
Polarizing Filter Set 1.25"	\$42.95		

SPOTTING SCOPES

C5 Spotter

- Fully multicoated optics
- Excellent light gathering ability
- Standard 8x20 erect image finderscope
- Near focus of 20'
- 45° erect image diagonal & 26mm Plossl 48x eyepiece - both 1.25"
- 22mm eye relief and 1" field of view with standard eyepiece
- Fitted with convenient tripod adapter block



C5 Spotter	\$599
80mm Wide View	\$199
50mm Zoom	\$99
60mm Zoom	\$69
30mm Mini Spotter	\$49

TRIPODS & MOUNTS

Heavy Duty Tripod (93499)	\$284.95
Photographic Tripod (93596)	\$99.95
Standard 8" Wedge (93656)	\$92.95
Heavy Duty Wedge (93659)	\$239.95
Upgrade Kit (93965)	\$109.95
Equatorial Mount CG-3	\$144.95
Equatorial Mount CG-5	\$369.95
CI-700 Mount	\$1,859.95
Vibration Suppression Pads	\$39.95

ACCESSORIES

AC Adapter	\$18.95	Lens Shades	CALL
Focus Motor	\$114.95	Motor Drives	CALL
Car Battery Adapter	\$18.95	T-Adapter (IC90)	\$28.50
Radial Guide	\$97.95	T-Adapter (USC's)	\$29.95
Case (IC5 & C8 (Most Models))	\$209.95		
Counterweight Bar Assembly 8"	\$89.95		
Counterweight Bar Assembly 11"	\$94.95		
DEC Motor (IC5+ Celestar 8, Ultima 9 1/4")	CALL		
Digital Setting Circles	\$299.95		
Flashlight Red Astro Lite	\$9.95		
Flashlight, Night Vision	\$21.95		
Focus Micrometer, Digital	\$109.95		
Hand Controller (IC3+ Celestar 8	\$49.95		
Piggyback Mount 8"	\$34.95		
Reducer/Corrector f/6.3	\$111.95		

FINDERSCOPIES

5x24	\$23.50	7x50 w/illuminator	\$159.95
6x30	\$39.95	9x50	\$44.95

TeleVue Visionary

Renaissance-101

101mm (4"), 540mm f/5.4
Available in Green or Ivory

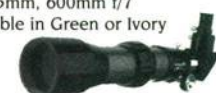
IN STOCK!



TV-85

85mm, 600mm f/7
Available in Green or Ivory

IN STOCK!



Pronto™

70mm ED, 480mm f/6.8
Available in Ivory or Green

w/1.25" 45° Erect Prism (RGA/RIA)	\$925
w/1.25" Star Diagonal (PGO/PIO)	\$945
w/2" Star Diagonal (PGD/PID)	\$1,085

Ranger

70mm ED, 480mm f/6.8
Available in Ivory, Green or Brass

w/1.25" 45° Erect Prism (RGA/RIA)	\$685
w/1.25" Star Diagonal (RGO/RIO)	\$695

Ranger Power Package

Includes: 90° Star Diagonal, 20-60x Zoom, 2.5x Powermate & Shoulder Bag (RPP2500) \$1,030

MOUNTS

TELE-POD MOUNT SYSTEM

Complete 7lbs Mounting System Ideal for Traveling	\$325
Ash Panoramic Mount	\$455
Ash Gibraltar Mount	\$530
Ash Gibraltar w/Sky Tour	\$1,210
Up-Swing Head	\$110

EYEPIECES

ZOOM EYEPIECE 8mm-24mm		\$210	
PLOSSL (50°)			
8, 11mm 1.25"	82	15mm 1.25"	210
15mm 1.25"	82	19mm 1.25"	240
20, 25mm 1.25"	95	22mm 2"/1.25"	280
32mm 1.25"	110	27mm 2"	330
40mm 1.25"	110	35mm 2"	365
55mm 2"	228	Barlow Interface	90
RADIAN (60°)		NAGLER (82°)	
3, 4mm 1.25"	228	4, 8mm 1.25"	175
5, 6mm 1.25"	228	7mm 1.25"	220
8mm 1.25"	228	9mm 2"/1.25"	240
10mm 1.25"	228	NAGLER Type 2 (82°)	255
12mm 1.25"	228	16mm 2"/1.25"	310
14mm 1.25"	228	NAGLER Type 4 (82°)	340
18mm 1.25"	228	12mm 2"/1.25"	370
NAGLER Type 5 (82°)		17mm 2"	370
31mm 2"	595	22mm 2"	445
BARLOWS			
2x 1.25"	105	2.5x Powermate	168
2x Big 2"	168	4x Powermate	265
3x 1.25"	105	5x Powermate	168

ACCESSORIES

RICH FIELD KIT Includes: 55mm Plossl, 2" Star Diagonal, SCT to 2" E.P. Adptr & 2" to 1.25" E.P. Adptr	\$410
RICH FIELD PREMIUM KIT w/Everbright 2" Star Diag.	\$480
Bino Vue Binocular Viewer	\$1,030
Paracorr Photo/Visual 2" Coma Corrector	\$235
NEW! Everbright 2" Star Diagonal Mirror	\$255
2" Enhanced Star Diagonal	\$190
1.25" Star Diagonal	75
1.25" Prism 45°	60
Air Chair	150
Basic Owik Point (OPU)	19.95
Starbeam Projection Finder	180
Camera Adapter 1.25" & 2"	36
Piggy-Bank Camera Adapter	42

TEL RAD

Finder Scope ... \$36⁴²

ASTRONOMY BOOKS

The Deep Sky: An Introduction

By Philip S. Harrington Here is the perfect reference for anyone, who owns a telescope or a pair of binoculars but doesn't know what to look for amid the constellations. It explains how to find double and multiple stars, variable stars, open and globular clusters, nebulae, and galaxies — what you'll see when you do. Includes 36 full-page sky charts; equipment, books, and software suggestions; sketches of how deep-sky objects look through a small telescope; and more than 100 black & white photographs. 272 pages.



The Deep Sky: An Introduction	\$24.95
Backyard Astronomer's Guide	\$39.95
Nightwatch: A Practical Guide to Viewing the Universe, 3rd Edition	\$29.95
Star-Hopping for Backyard Astronomers	\$19.95
Celestron Sky Map	\$6.95
Meade Star Chart	\$6.95
Sky Atlas 2000	
Deluxe Edition	\$49.95
Desk Edition	\$27.95
Field Edition	\$27.95
Laminated Deluxe Edition	\$9.95
Laminated Desk Edition	\$9.95
Laminated Field Edition	\$9.95

JMI JIM'S MOBILE INC.

Next Generation Computers
Motofocus • NGF Focuser
Wheely Bars • Motodeck

THOUSAND

O A K S

Precision Glass Solar Filters
Mounted Type 2
Mounted Type 2 Plus
Mounted Type 3 Plus

ASTRONOMY SOFTWARE

RedShift 3

CD f/Windows \$44²⁵

CD f/Macintosh \$44²⁵

The Sky

Level IV, Ver. 5

CD f/Windows \$239⁹⁵

SkyMap Pro 6.0

CD f/Windows \$89⁹⁵

SkyChart III CD \$38²⁵

Take advantage of our **LARGE INVENTORY!** Immediate shipment from stock!



condition, unused as received with papers & packaging intact. We gladly accept and reply to written or faxed inquiries. Ad prices available while supplies last. This ad supersedes all previous ads. Focus camera is not responsible for typographical errors. Hours: Mon.-Thurs. 9-7, Fri. 9-2, Sun. 10-6.

Sunsational Photography

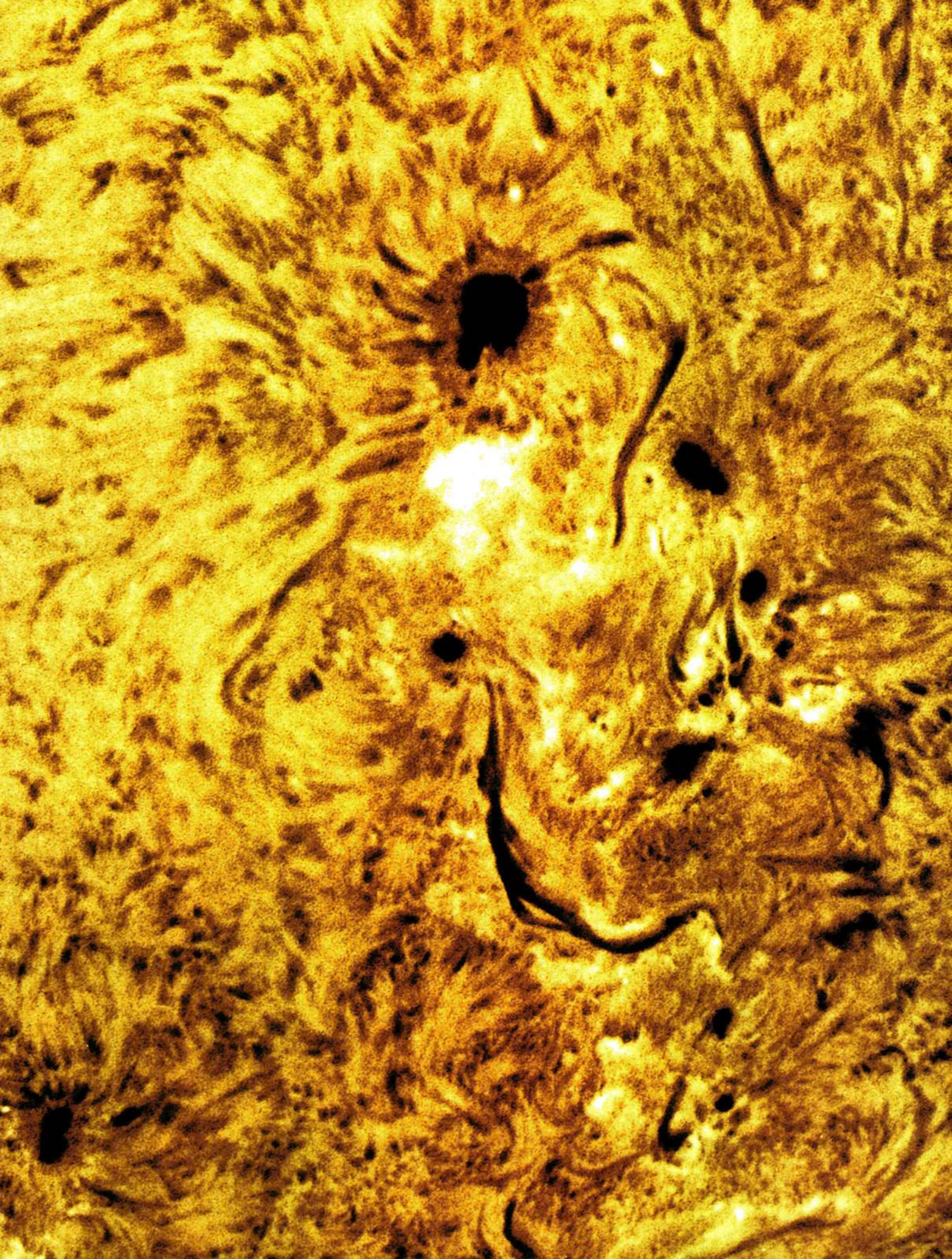
Astrophotographers discover the many pleasures of monochromatic light thanks to hydrogen-alpha filters.

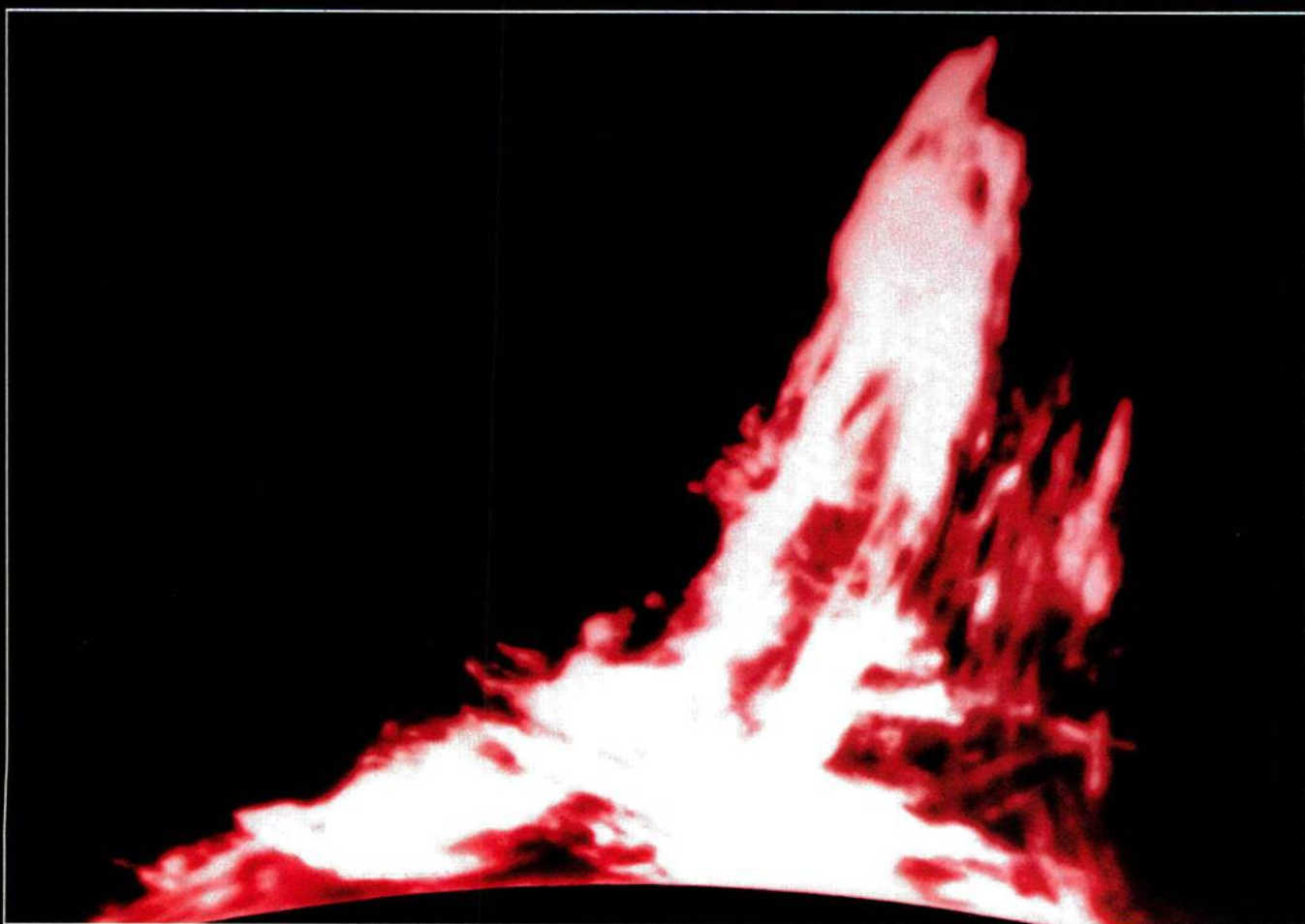
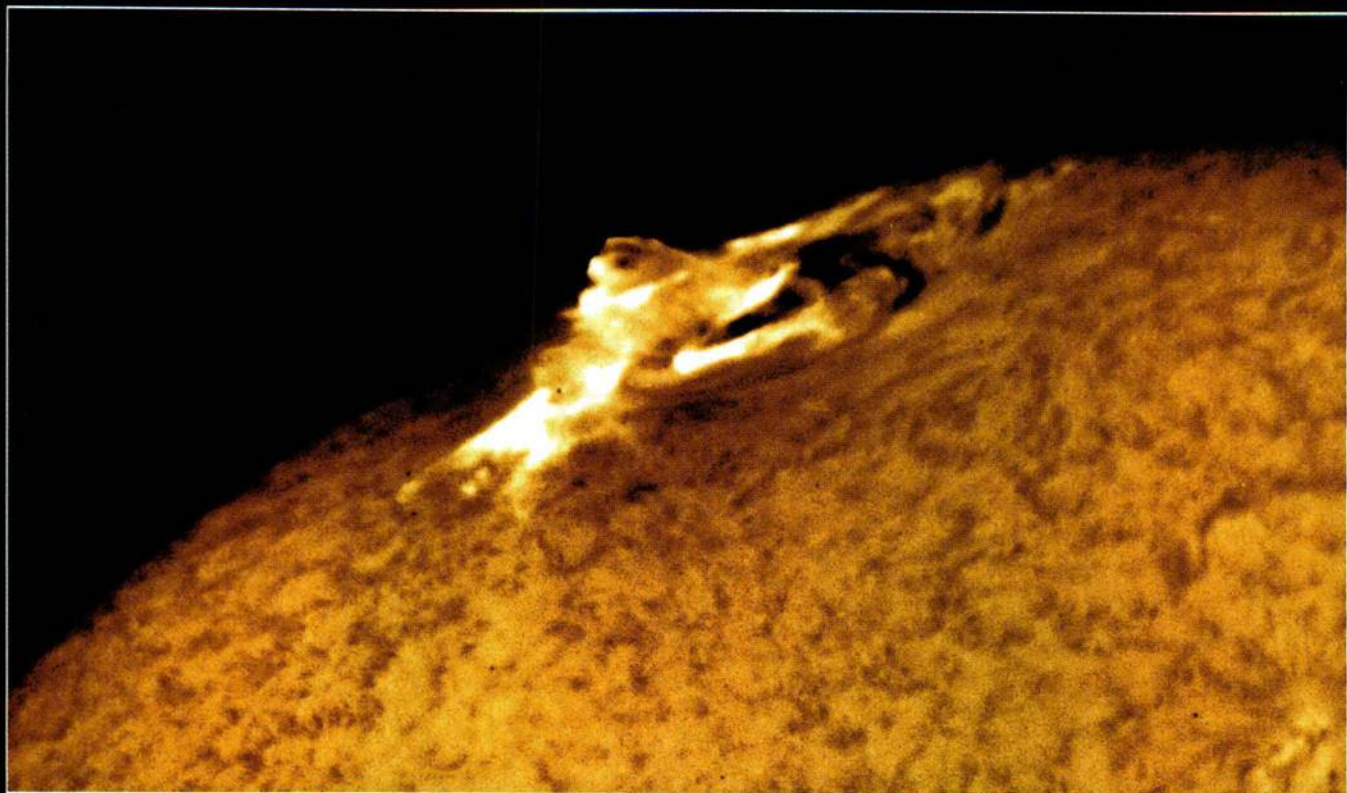
Text and photographs by Jean Dragesco

Astronomy breeds its own brand of sun worshipers. And just as sunbathers choose from a range of SPF lotions that block sunlight to suit their skin type, astronomical sun lovers do the same by selecting a solar filter that best fits their viewing and photographic needs. One of the most specialized of these is the hydrogen-alpha ($H-\alpha$) filter, which allows observers to witness an amazing variety of solar activities and rewards astrophotographers with stunning photographs of these events.

As seen through an $H-\alpha$ filter, solar special effects put George Lucas's Industrial Light and Magic to shame. The $H-\alpha$ wavelength of 6,563 angstroms ($\text{\AA}$) reveals fascinating chromospheric phenomena: spicules, filaments, flares, prominences, and more. Yet, whatever intrigue and pleasure accompany this very narrow band pass of visible light, it brings with it an even narrower band of observers willing to enjoy the view — $H-\alpha$ filter prices start at around \$3,000. Even so, many amateur astronomers assuage their passion and buy it. The rest of us should only be lucky enough to know someone with an $H-\alpha$ filter who lets us enjoy the view. *(continued on page 94)*

An $H-\alpha$ filter highlights active solar spots in this high-resolution photograph.





Top: Showtime: A giant sunspot gives a performance that includes this powerful eruption.

Bottom: Solar prominences undergo rapid, dynamic changes as they shoot into space.

Tips From an Experienced H- α Astrophotographer

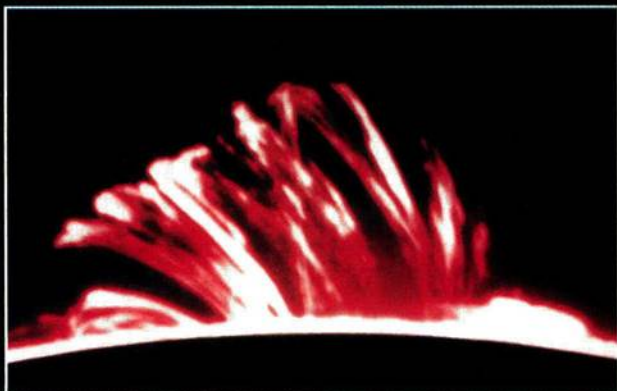
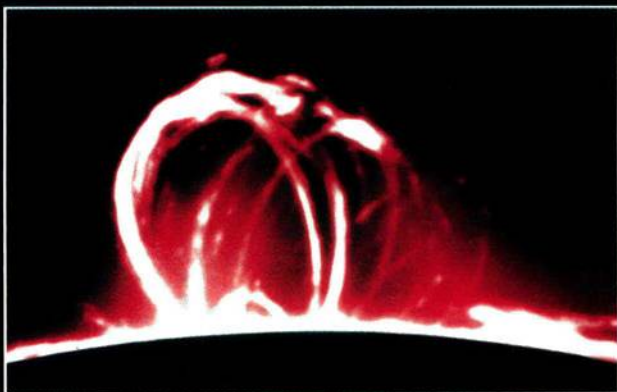
Since retirement, I have taken thousands of photographs during daily H- α observations of the sun. Seeing conditions often make the unit inoperative, and I have never achieved the theoretical resolution of one arcsecond. Instead, I concentrate on taking photographs of noteworthy prominences, flares, or active regions.

My Leica M cameras are reputed for their gentle shutter-release qualities and my Leitz Visoflex-3 endoscopic reflex system allows for manual mirror adjustments. Even then, I am usually only satisfied with two to four negatives from each 36-exposure roll of film.

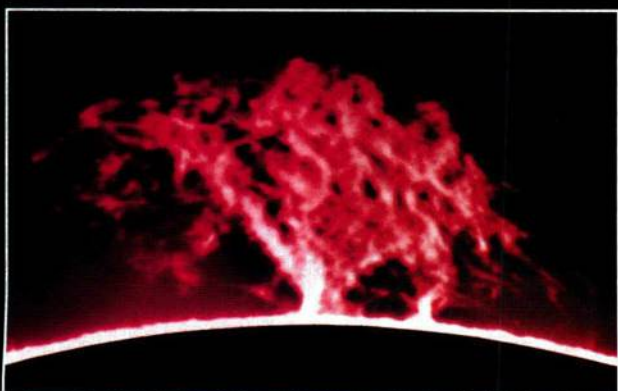
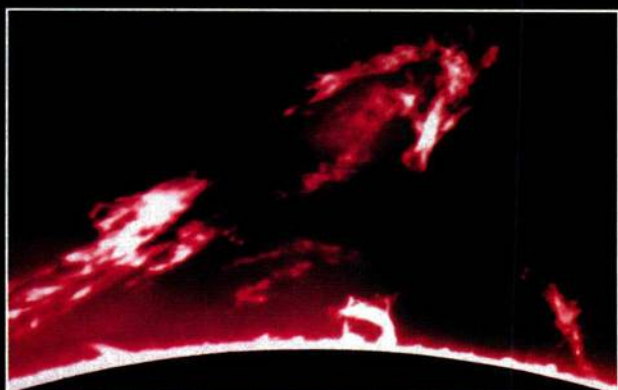
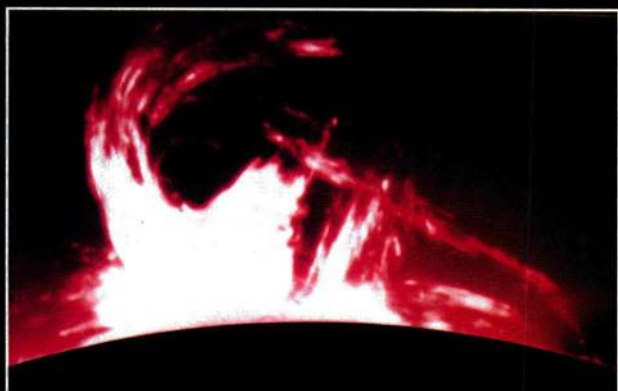
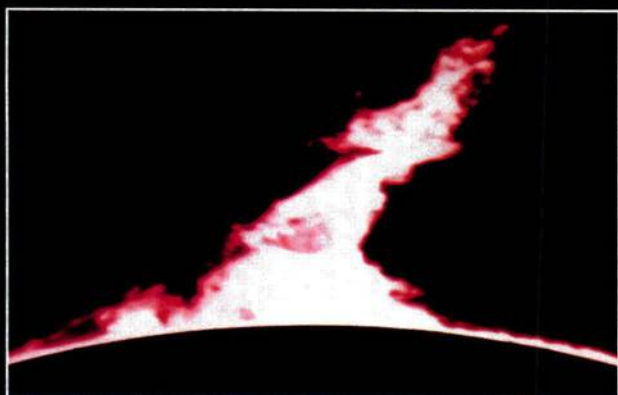
While my DayStar 0.6 Å University H- α solar filter is the most expensive small object that I have ever purchased, I have no regrets. Here is what I learned through experience:

- Use a telescope with a focal length of f/30 or greater.
- Make sure the H- α unit reaches thermal equilibrium before shooting.
- Set exposure times according to the sun's position and atmospheric conditions: Use $\frac{1}{60}$, $\frac{1}{50}$, and $\frac{1}{40}$ second for details of the solar disk and $\frac{1}{2}$, $\frac{1}{4}$, or $\frac{1}{3}$ second for solar prominences. (I use two Leica cameras, one for prominences and the other for the chromosphere.)
- Bracket all photos. I take six to nine shots, adjusting the focus – both on the reticle and the sun – each time. I position my C-14 at right angles to the sun at about 1 P.M. and 3 P.M. in winter and summer, respectively.
- Use Kodak black-and-white Technical Pan 2415 film for the best standard of resolution and contrast. (All photos illustrating this article were colorized.)
- Use medium contrast when developing prominence shots and use high-contrast techniques for chromospheric films.
- Enlarge shots of prominences by a factor of 15 exactly.
- Center the prominence on a sheet of 13x18-inch paper taped to the enlarger plate.
- Tape photographic paper to the first sheet.
- Harmonize the various parts of the prominence during exposure; control contrast with multigrade paper, masks, and local modifications.
- When the exposure is complete, remove the negative from the enlarger, cover the prominence with an opaque mask matching the enlarged curvature of the sun, and blacken the overexposed solar disk. This results in a coronagraph effect (black sun).
- Understand that densities of H- α filter negatives vary and often produce very poor prints.
- Crop to a smaller portion of the chromosphere negative for better results.
- Number 5 paper enhances weak contrast by improving definition of details.
- Harmonize printing as much as possible by burning, dodging, or using a mask. This is sometimes nearly impossible and I've often ended up with only one successful print from ten negatives.
- Expect to use lots and lots of film.

Jean Dragesco uses his favorite toy, a DayStar University H- α solar filter, along the hillsides in Saint Clément, near Montpellier, France. Asteroid 12498 is named Dragesco to honor his work in planetary photography.



Top to bottom: Some prominences form giant coil shapes due to magnetic field lines; a similar coil-shaped prominence is captured at a different angle; the estimated height of this explosive prominence is about 193,000 miles (roughly 312,000 km).



Top to bottom: A large solar prominence takes shape; this 1/2-second exposure catches an arcing prominence; a solar horsehead rears away from the sun; in only half a second, a treelike prominence billows up and away.

And what a view.

Thanks to its construction, an H- α filter works like a miniature interferometer. Parallel, metal-coated glass plates and quartz crystals cause light entering the filter to undergo a series of interferences. Multiple reflections between the inner surfaces of the filter transmit light at different wavelengths, cutting undesirable radiation and isolating the H- α spectral line. Within that line, an H- α filter divides the wavelength further, allowing observers to focus on specific phenomena. Prominences show up best with a filter that isolates a wavelength range or band pass that's 0.7 Å wide. A filter width of 0.5 Å shows chromospheric detail best. Overall, though, the dream solar filter for astrophotographers remains the model with a band pass width of 0.6 Å.

With this dream comes an almost nightmarish set of precise requirements for successful results in H- α photography. Filters must remain at exactly the correct operating temperature at all times. Even slight temperature variations cause a visual Doppler effect that bends the wavelength. Overheat the filter and the blue end of the spectrum dominates. Cooling it too much favors the red wavelength. For optimum viewing conditions, users must also adjust the telescope's tilt so that it captures nearly parallel rays of sunlight.

These temperature and tilt adjustments help assure that the prefilter, or energy rejection filter (ERF), works properly. The ERF blocks out the majority of unwanted wavelengths and is the portion of the filter that ages with time. As the workhorse of an H- α filter, the ERF not only eliminates infrared and ultraviolet spectral lines, but also removes other invisible but harmful wavelengths. What's left filters through and delivers a pure visual tone of H- α light. **A**

H- α Filter Dealers

DayStar Filters

3857 Schaefer Avenue Suite D
Chino, CA 91710
(909) 591-4673
Fax: (909) 591-6886
(No e-mail available.)
<http://www.daystarfilters.com>

Oceanside Photo & Telescope

1024 Mission Avenue
Oceanside, CA 92054
(800) 483-6287
Fax: (760) 722-8133
E-mail: opt@optcorp.com
<http://www.optcorp.com>

Coronado Filters

Coronado Manufacturing Unit KC 1
Balthane Industrial Park - Ballasalla
Isle of Man IM9, 2 AH, UK
Phone: 44 (0) 1624825410
Fax: 44 (0) 1624825420
In the U.S.: (866) 786-9282
Fax: (520) 824-3216
E-mail: info@coronadofilters.com
<http://www.coronadofilters.com>

Hands on Optics

26437 Ridge Road
Damascus, MD 20872
Phone/fax: (301) 482-0000
E-mail: astroguy@handsonoptics.com
<http://www.handsonoptics.com>

Pocono Mountain Optics

104 NP 502 Plaza
Moscow, PA 18444
Orders: (800) 569-4323
Info: (570) 842-1500
Fax: (570) 842-8364
E-mail: pwo@poconoscopes.com
<http://www.pocmntop.com>

Pocono West Optics

2580 S. Decatur #3
Las Vegas, NV 89102
Orders: (800) 635-3607
Info: (702) 252-7200
Fax: (702) 252-7130
E-mail: pwo@poconoscopes.com
<http://www.pocmntop.com>



2
GREAT
LOCATIONS

Penna.-POCONO MOUNTAIN OPTICS

Las Vegas-POCONO WEST OPTICS

ORDERS: 800-569-4323
INFO: 570-842-1500

ORDERS: 800-635-3607
INFO: 702-252-7200



POCONO GLADLY ACCEPTS:
with no surcharge



\$7.00 MINIMUM SHIPPING/
UPS (in U.S.)

• Purchase Orders from Qualified Institutions Gladly Accepted
• We Purchase and Take In Trade Used Telescopes

Visit Our Two Showrooms in Moscow, PA
and Las Vegas NV!

We carry the following lines & products
for all of your astronomical needs:
See online or printed catalog for full
details:

ACCESSORY CASES
ADIRONDACK VIDEO
APOGEE
APOGEE INSTRUMENTS
ASTROMETRICS-GO TO SYSTEMS
ASTRO SYSTEMS
12-VOLT BATTERIES
BRANDON
BUSHNELL
CELESTRON
COLLINS ELECTRO OPTICS
CORONADO H-ALPHA SYSTEMS
DESERT STORM COVERS
FUJINON BINOCULARS
HOMER FLIP MIRRORS
JMI
KENDRICK
LASER MAX
LOSMANDY
LOMO
LUMICON
MEADE
OPTIC
PARALLAX
PENTAX
QUESTAR
RIGEL SYSTEMS
SBIG
SOFTWARE BISQUE & SOFTWARE
TAKAHASHI
TECH 2000 DOB DRIVERS
TECTRON
TELE VUE
TELRAD
THOUSAND OAKS SOLAR FILTERS
UNIVERSITY OPTICS
POCONO SPECIALS & MORE

COMPUTER SOFTWARE
"THE SKY" by Software Bisque
CCD Soft.....\$219.00
Starry Night Deluxe.....\$89.95
Star Chart 3.....\$39.95
The Sky, Level 4
Version 5
Now Available.
Max DL Imaging Software.....\$365.00



**OBSERVE IN
COMFORT**
with
STAR PARTY
VIEWING CHAIR

• Portable, Adjustable from 9" to 32"
• Padded Seat
• Porcelain Black Powder Coated
Available in Black Only
Dealer Inquiries Invited **\$159.00**

TELRAD w/Base
\$39.00
Batteries included!
Hinged Deluxe Dew Caps.....\$10.00
Extra Bases.....\$ 7.95
Extra Reticles.....\$ 2.95
Pulsar Unit.....\$19.95

RIGEL SYSTEMS
Starlite Dual LED Flashlight.....\$22.00
NEW Skyline: Dual Color LED Flashlight.....\$29.95
Quick Finder-New Version.....\$35.00

KENDRICK ASTRO INSTRUMENTS
Stay ahead of those
soggy fall nights!
The Kendrick Dew Remover
System for all size scopes,
finders and mirrors
Keeps optics clear of dew,
extending precious viewing time.

**VISIT OUR 50+ PAGE ON LINE CATALOG WITH SECURED
24 HOUR ON LINE ORDERING AT: www.PoconoScopes.com**
Look for our Monthly On-Line Specials! Call or write for our printed catalog & specials.

YOUR MEADE AUTHORIZED ADVANCED PRODUCTS MAIL ORDER DEALER



Meade **LX-200**
SCT's, The World Fa-
mous "GoTo" Telescope
Available in 8" F/10 or
F/6.3, 10" F/10 or F/6.3,
12" F/10, 16" F/10.



Meade Dobsonians:
Available in: 6" F/8,
8" F/6, 10" F/4.5,
12.5" F/4.8, 16"
F/4.5, optional de-
luxe accessory
package \$49.95



New Meade ETX-90/EC and
ETX-125/EC - with
pushbutton electronic
control comes standard
with dual-axis drive system
W/4 dual axis speeds. Add
the Meade Autostar hand
control to your scope and
get fully automatic go to
capability to over 12,000
objects. The ETX-125/EC
has 5" of Aperture & RA
Finder. Available Now.
ETX-90/EC \$595.
ETX-125/EC \$895.
Original ETX-90 RA \$495.

ALL DS SCOPES AVAILABLE

ACCESSORIES FOR ETX-90 RA, EC, 125EC

#126 Barlow.....\$47.95
#64 T-Adapter.....\$34.95
#932 Image Erect Diagonal.....\$49.95
Hard Case for 90.....\$99.95
Soft Case for 90 RA & EC.....\$39.00
07329 #775 Hard Case for ETX-125EC.....\$155.00
8X25 right Angle Finder for 90.....\$49.95
Auto Star Hand Control for 90 & 125 EC.....\$149.00
Equatorial Table Top Tripod (w/Hi Lat Leg).....\$29.95
Equatorial Table Top Tripod (w/Hi Lat Leg) for 125 EC.....\$55.00
Deluxe Field Tripod.....\$199.00
07077 #1244 El. Focus for all ETX-90's.....\$119.95
07078 #1247 Elect. Focuser-ETX-125EC/S.scope.....\$119.95

DS SERIES ACCESSORIES

07437 #495 Autostar (hand box only).....\$99.
07438 #492 Dual Motor Elect. Control System.....\$129.
07439 #493 Autostar, Complete System.....\$199.
07076 #1240 Elect. Focuser.....\$75.
07041 #490 Elect. Focuser.....\$75.
07221 #937 2" Diagonal Mirror w/.96 & 1.25" Ad.....\$45.

Meade 8" LX-10.....\$995.
Super Wedge.....\$395.
New Field Deratorator for 8", 10", and 12" SCT's,
and 7" Maksutov.....\$395.



**New ETX-60 \$299.&
New ETX-70 \$349.
Now Available**



**NEW
8" LX-90 SCT
\$1695.**



World Renown
Series 4000 Eyepieces
Complete line in stock
for immediate delivery!
**NEW Meade Series 4000
8MM to 24MM Zoom
Eyepiece \$219.95**

Tele Vue "WHEN YOU WANT THE FINEST"

We stock the entire Tele Vue line for immediate shipment. All items also on display and
available for purchase and pick up at both of our showrooms.



NAGLERS 82° Apparent Field of View
Choose from 4.8 MM \$175., 7 MM \$220.,
9 MM \$240., 16 MM \$310.
New Type 4 12MM Nagler \$340.
Orders now being accepted for the 17MM and 22MM Type
4 Naglers
Type 5 31 Nagler \$595
RADIANS 60° Apparent Field of View, 20 MM eye relief
Avail. in 3, 4, 5, 6.8, 10, 12, 14, & 18 MM \$228.00
PANOPTICS 68° Apparent Field of View
15MM \$210., 19MM \$240., 22MM \$280.,
27MM (2") \$330., 35MM (2") \$365.

MONTHLY SPECIAL
PRONTO w/2" DIAGONAL Panoramic Mount and Quick Point Finder
POCONO MOUNTAIN OPTICS EXCLUSIVE

2.5x Powermate.....\$168.00
5x Powermate.....\$168.00
New 4x Powermate now avail. \$265.
New Bino Vue.....\$1030.00
8MM to 24MM ZOOM.....\$210.00
New Everbrite 2" Star Diag.....\$255.00



**NEW TV-102
In Stock
\$2050.**

Ranger, Pronto, TV-85 in stock



CELESTRON

We carry the full line of Celestron Telescopes and Accessories

NEW NEXSTAR 5 & 8



JUST ARRIVED!
Flawless go-to
and tracking.
Superb optics,
very quiet. A real
winner! Nexstar
5 \$1199.
Nexstar 8 (w/tripod)
New Low Price
\$1699!

CELESTAR 8 DELUXE



2032 MM FL., Heavy Du-
ty Adj. Tripod Dec Motor
and Hand Control. 4
Tracking Rates and PEC
Fastar Compatible. In
Stock for Immediate
Shipment. \$1699.
Celestar 8, reg. version
\$1099.

ULTIMA 2000



Ultra Quiet Motors and Go
To Impressive Pointing
Accuracy. Runs off 8 AA
Batteries. Enhanced En-
coder Resolution. Fastar
Compatible at F-2 for CCD
use. 9X50 Finder. In Stock
and Impressively Priced.
\$2699.

DESERT STORM COVERS

Protect your investment!
Covers available for all size scopes.
Manufactured with a thick mylar
"heat resistant" material



4" - 6" Dobs & SCTs.....\$21.95
7" - 8" Dobs & SCTs.....\$26.95
10" - 13" Dobs & SCTs.....\$32.95
14" SCTs.....\$38.95
16" - 18" Dobs.....\$44.95
20" - 25" Dobs.....\$54.95
Dealer Inquiries Invited

ORDERING & SHOWROOM HOURS

Penna.-POCONO MOUNTAIN OPTICS
Order: 9-9 Mon.-Fri., 9-5 Sat., 12-5 Sun.
Showroom: 10-5 Mon.-Sat., 12-5 Sun.
Las Vegas-POCONO WEST OPTICS
Order: 9:30-6 Mon.-Fri., 10-5 Sat.
Showroom: 9:30-6 Mon.-Fri., 10-5 Sat.
Prices and specifications subject to change



Penna.-POCONO MOUNTAIN OPTICS
104 N P 502 Plaza, Moscow, PA 18444
FAX NO. 570-842-8364 Visit our Website at: www.PoconoScopes.com
E mail: pmo@PoconoScopes.com



Las Vegas-POCONO WEST OPTICS
2580 S. Decatur #3, Las Vegas, NV 89102
FAX NO. 702-252-7130 Visit our Website at: www.PoconoScopes.com
E mail: pwo@PoconoScopes.com Mention Ad A-7

**No gimmicks
just service,
selection... and great prices!**

**Knowledgeable
staff
to answer all
your questions.**

**Telescopes
our
specialty**

**CELESTRON®
showcase
dealer**

**THE
TELESCOPE
STORE**

**114 short
with tripod
\$199**

**C150 HD
with tripod
\$499**

**Nexstar 5
with tripod
\$1,398**

**Nexstar 8
with tripod
\$1,899**

**www.telescopes-earth.com
(800) 550-7192**

www.camcor.com

One of the largest Selections

- Telescopes • Spotting Scopes
- Binoculars • Tripods • Eye Pieces
- Accessories • Cases • Books
- Maps • Globes
- Cameras • Film
- Processing

All Name Brands Available

- Bushnell • Canon • Celestron • Fujinon • JMI • Kowa
- Leica • Meade • Nikon • Pentax • Tele Vue • SBIG • Steiner

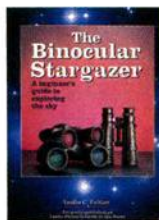
Camera Corner
Established 1949
2273 South Church St. • Burlington, NC 27215
Voice 336-228-0251 • Fax 336-222-8011
e-mail: sky@camcor.com

800-868-2462

Your Guides to the Heavens



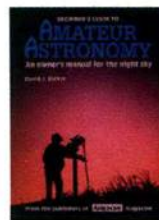
Tips on finding more than 600 of the finest deep-sky objects with a backyard telescope. Takes you on a tour of 46 constellations throughout the sky. Includes detailed color photos and maps of constellations. From *Astronomy Magazine*. 8 1/2 x 11; 188 pgs.; 50 b&w and 90 color photos; hardcover. 18037..... \$29.95



Explains binocular stargazing for beginners with helpful sky observation tips. Includes maps of the sky, seasonal stars, and information on how to see the Moon, planets, comets, and meteors. 7 1/2 x 9 1/4; 160 pgs.; 10 color photos; 47+ illus.; softcover. 18544..... \$19.95



Presents glorious views of the night sky from both hemispheres with exceptional high-quality sky photographs and matching star maps. Shows stars as they're actually seen by the naked eye or with binoculars, and includes 50 detailed star charts and tables. 11 1/2 x 8 1/4; 224 pgs.; 56 color photos; hardcover. North American customers only. 18549..... \$59.95



Gets beginners off to a great start! Introduces the hobby of astronomy with observation and photographic tips. Identifies the best sky objects to observe using the naked eye, binoculars, and backyard telescopes. 7 1/2 x 9 1/4; 166 pgs.; 80 b&w and 80 color photos; softcover. 18540..... \$19.95

Ask for these products at your favorite bookstore! Or order direct:

Call 1-800-533-6644

Mon-Fri, 8:30am-5:00pm Central Time. Outside the U.S. and Canada, call 262-796-8776. Please have your credit card ready.

Fax orders to 262-796-1615.

To order by mail: Send your order to Kalmbach Publishing Co., Dept. A1839, 21027 Crossroads Circle, P.O. Box 986, Waukesha, WI 53187-0986.

Use chart at right for shipping & handling charges.

5674-0012

Order online

www.kalmbachbooks.com

Secure online ordering available.

Merchandise total	Add for shipping
\$10.00 or less	\$3.95
\$10.01-\$30.00	\$4.95
\$30.01-\$50.00	\$5.95
\$50.01-\$75.00	\$6.95
\$75.00 or more	\$7.95

Canada add an additional \$2.00, other foreign add an additional \$5.00. For Wisconsin delivery, add 5% sales tax to total; for Pennsylvania delivery, add 6% sales tax to total. For delivery in Canada add 7% GST to total. Payable in U.S. funds. Prices and availability subject to change.

Astronomy

A1839



synctime metallic mesh band, metal bezel mineral lens, hi-tech polymer case \$149.95



atomic radio with 2 alarms and temperature, day, date, LCD \$39.95



NEW

Junghans atomic carbon, stainless bezel, sapphire lens LCD day date - carbon/leather band • \$279.00

definitely atomic clock
definitely precise
definitely self setting

with the world's most accurate time pieces, atomic clocks & watches from

ATOMIC TIME™

- watches for any time zone
- synchronized to the u.s. atomic clock in fort collins/co
- accurate to 1 second in 1 million years
- engineered in germany

complete line of atomic clocks
Junghans full ceramic or carbon fiber atomic watches in 12 styles, sapphire lens, bright lumi. hands

for nighttime, waterresistant Junghans solar watches

Junghans since 1861
over 100 different Atomic Time watches & clocks for home and office & weather stations

20% off second item

call for our free brochure:
or go to www.atomictime.com
credit card orders call toll free

1-800-985-8463

send checks/money orders for the total amount incl. s&h \$6.95 to

ATOMIC TIME, INC.
1010 JORIE BLVD.
OAK BROOK, IL 60523



atomic dual alarm clock w. temperature day and date, black 3.5x4.5x2" \$29.95



jumbo digit atomic clock w. temperature & day and date, wall or desk 8.5"x8.5"x1" • \$49.95



black arabic 12" wall clock for home or office • \$59.95 (wood \$69.95)

ASTRO PIER Telescope Mounting Piers



Are you tired of leveling and lining up on North? The Astro Pier virtually eliminates vibration from accidental jarring and totally eliminates the need to level and line up on North, allowing for undelayed observing and excellent astrophotography. Constructed from 1/4" and 3/8" welded steel with three 3/4" leveling bolts for excellent performance.

Mounting piers for Schmidt-Cassegrain, Refractors and Newtonian.
Color: Midnight Blue, Black or White

LE SUEUR MANUFACTURING CO., INC.

3220 Loma Road
Birmingham, Alabama 35216
Phone (205) 822-0720
Starting at \$321.00 plus S/H

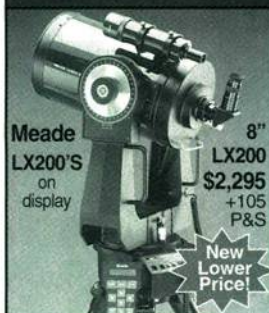
VISA/MasterCard NO C.O.D.s

WEBSITE: WWW.ASTROPIER.COM

Rivers CAMERA SHOP

"Call for our informative catalog"

**AUTHORIZED MEADE® APD
MAIL-ORDER DEALER**



Meade LX200's on display
8" LX200 \$2,295 +105 P&S
New Lower Price!



Meade DS-127EC

\$499.95 +30 P&S

Meade ETX-125/EC
\$895.00
+30 P&S
in stock!



ETX Accessories
#126 2x Barlow \$47.95
#64 Camera Adapter \$34.95
ETX Tripod \$199.95

Most Meade Products In Stock/On Display!

- Meade Starfinder
- Dobsonians & Equatorials
- ETX 60 + 70 AT
- DS70, DS80, DS90, DS114, DS127
- Meade Series 3000 and 4000 Eyepieces
- Most other Meade accessories in stock

AUTHORIZED CELESTRON® DEALER



NEW Nexstar 5 in stock
\$1199.95 +20 P&S

New CELESTRON®

Nexstar 8 inch

Including Tripod
\$1699.95 +30 P&S

Most Celestron Products In Stock!

- Celestron Star Hopper
- Ultima Series Eyepieces
- First Scope 60's, 70's, 80's & 114's in stock
- Celestar 8 SCT's
- Accessories in stock
- LED flash lights



Collins Image Intensifier In stock
See what you have been missing!

New Location!
179 Water Street
Exeter, NH
(603) 778-1990

Why Buy From Us?

NE's Largest Telescope Display

Mail-Order or In-Store. No Sales Tax!

Used Scopes - Buy, Sell or Trade-In

Knowledgeable, Helpful, Friendly Staff

TeleVue®

Rivers CAMERA SHOP

454 Central Ave.
Dover, NH 03820
Phone: (800) 245-7963 • Fax: (603) 742-5456
Hours: M-TH 8:30-6:00, Fri. 8:30-8:00, Sat. 8:30-5:30
www.riverscamera.com



Embracing the Sun

The last eclipse of the 20th century offers North American viewers a chance to see the moon block out part of the sun.

by Richard Talcott

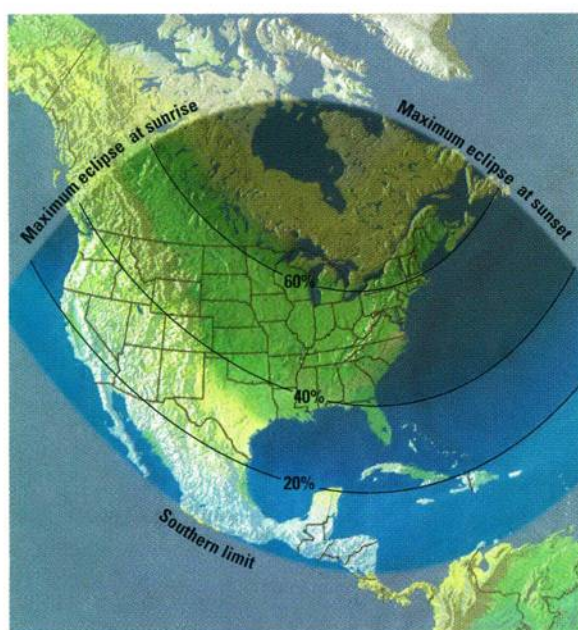
To many people, Christmas evokes memories of family gatherings, basking in the glow of a warm fire, and, at least for those of us with a sweet tooth, munching holiday cookies. With a little luck, December 25, 2000, will bring all those things and more. If you're willing to leave your spot by the fire and brave the chill December air, you can watch the moon satisfy its celestial hunger by taking a bite from the sun.

If skies are clear, nearly all of North America will get to see this partial solar eclipse. Only a few coastal areas in southern Mexico, where the moon skims just north of the sun, and Alaska and far northern Canada, where the sun doesn't rise in late December, miss out on the action.

The eclipse starts along the West Coast, where for many people the sun rises in eclipse. The farther east you live, the later in the day the moon's shadow will come to your area. The amount of the sun that disappears ranges from just a few percent in southern Mexico up to 70 percent as you approach Baffin Island in Canada.

Watching a partial eclipse can be dangerous, of course, because the sun's brilliance is only slightly diminished by the moon's presence. During the last total solar eclipse visible from the eastern United States, on March 7, 1970, nearly 150 people suffered some eye damage during the partial phases. Half of them never regained their full eyesight.

Left: A partial solar eclipse will greet observers throughout most of North America on December 25, 2000. Jay Pasachoff



The key to safely viewing the partial eclipse directly is to use a high-quality solar filter. This month *Astronomy* has bound solar eclipse glasses into the magazine. You can follow the eclipse's progress with your naked eye through these glasses but they are not designed to be used with binoculars or a telescope. Other good filters include commercially available Mylar filters and metal-on-glass filters or a #14 arc-welder's glass. These materials cut the amount of visible light by a factor of several hundred thousand

and all the sun's even more dangerous ultraviolet and infrared radiation.

If you prefer an indirect view of the eclipse, try constructing a simple pinhole camera. You need two pieces of cardboard and some aluminum foil. Cut a modest-sized hole in one piece of cardboard and tape the aluminum foil over it. Then use a straight pin to poke a small hole in the foil. To view the eclipse, have the sun's light pass through the pinhole onto the second piece of cardboard.

Also be aware of filters that won't protect your eyes. Never use a "sun filter" that screws on the bottom of a telescope's eyepiece because they can crack when in use. Also avoid sunglasses, smoked glass, exposed black-and-white or color film, or photographic neutral density filters. Although all these materials limit the amount of visible light passing through, they do little to stop infrared radiation. And finally, don't even think about using the 3-D glasses that came with your December 2000 issue — they won't protect your precious eyesight either. **A**

New Accessories CHRISTMAS SALE MEGAPOD

Megapod now with
polar alignment tube

The MEGAPOD has
blinking red lights at
the tips of the feet
to prevent accidentally
bumping the legs.
(The last thing you
need is to do a computer
star realignment because
your telescope accidentally
got bumped.) A toggle
switch activates the lights.

- Convenient storage for your eyepieces
- Convenient holder for your Autostar
- Adjustable legs with bubble level
- NO Fumbling to get screws into blind holes - Telescope slides into place

MEGAPOD for
ETX-90, ETX-90EC,
ETX-125EC, NexStar5 \$229.00 (\$14)

Folds to 31" - Extends to 50"
Adjustable with latitude scale (0° to 90°).

\$20 OFF

All Megapods and cases

(Take \$20 off listed prices
from December 1 through December 31)

SOLID STEEL
Made in the U.S.A.

SOLID AS A ROCK

16 gage Steel Legs

Thicker than the

Fenders on your car!

Only tripod available with

FLASHING LIGHTS

BEST FOAM
IN THE INDUSTRY

Foam Lined
Carrying case

ETX 125-EC \$149.95 (\$8)
NextStar 5 \$149.95 (\$8)
EXT-90, ETX-90EC \$109.95 (\$7)

- Holds 6 eyepieces.
- Professional Die-Cut Foam Lining
- Top & Bottom (No cubes to fall out).
- Compartment to hold eyepieces, hand controls, etc.

Now available for ETX 125

Only MOTOTRAK V
gives you after-market PEC.
Drive corrector works with all
scopes using 110vAC/60Hz
RA drive motors.

MT5-110 volts \$399.00 (\$8)

Breakthrough Integrated
Digital Focus Counter
with Heavy Duty MOTOFOCUS.
Great for CCD work.
999 on display = 10 turns.
Fits all Meade and
Celestron SCTs and MAKs,
7" through 14" MOTOFOCUS
with DFC

\$169.90

EZAlign

Polar alignment scope

- Fits fork mounted Telescopes
- Easy to install, No Drilling
- No Need to Remove for Transport
- Illuminated reticle included

\$220.00 (\$6)

MOTODEC for most
popular Telescopes
as low as . . . \$99.95 (\$6)

Our after-market
computers fit over 100
Models of Telescopes

MEDIUM SIZE
UNIVERSAL WHEELY BARS

Move your scope with ease, level,
lock the wheels, fits most Meade
2080/2120, Star finder 6/8/10, most
SCT's up to Ultima 11, adjustable
tip-to-tip distance 31 to 41 inches.
TPWUMED \$169.95 (\$15)

LARGE SIZE
UNIVERSAL WHEELY BARS
For Meade Giant Field Tripod, Meade
LXD700/750 and Celestron CI-700
TPWULG \$229.95 (\$25)

Breakthrough
Design from JMI

"Go To" SYSTEM
FOR
OBSESSION

JMI Nightrider™
TRACK-N-GO

Nightrider

must be purchased directly from JMI
or Obsession Telescopes only.

- 14,942 objects
- Compatible with TheSky software
- 0.1x to 1000x guiding and slewing speeds
- Complete with motors and a drive system developed by JMI
- Very easy to install
- Includes: Dual axis hand controller, RS-232 serial cable for connecting to a PC, 12v rechargeable battery with charger, AC adapter, Bracket for hand held computer

Nightrider for Obsession telescopes \$1695.00 (\$20)

In stock now for 15".
Other models coming soon. Watch the web

Call now
1-800-247-0304

Visa & Mastercard accepted.

(www.jimsmobile.com)

Jim's Mobile Inc. • 810 Quail St. Unit E • Lakewood, CO 80215 • Orders: 800-247-0304 • Info: 303-233-5353 • Fax: 303-233-5359

JMI's (www.jimsmobile.com) HOT PRODUCTS SHOWCASE

Replace plastic and other low-quality focusers with real quality. Our new revolutionary reverse Crayford focuser is so simply designed, it breaks the price barrier. It has all the same Crayford qualities—smooth focusing, zero image shift, stainless steel bearings, leveling screws and the coolest knobs—but at a fraction of the weight and price. It is now available in kit form. Assemble it yourself and save big.



Now Available for StarFinder

Add \$9 for longer draw tube.
See Web for details.

pat. pending

(Kit Focusers are only available through JMI.
The price is reduced so low that there is no room for a Dealer margin.)

"Monorail"

Reverse Crayford Focuser

As Low As... **\$59.00**

1 1/4" Kit
2" Kit
1 1/4" Factory Assembled and tested
2" Factory Assembled and tested

\$59.00 (\$7)
\$79.00 (\$7)
\$79.00 (\$7)
\$99.00 (\$7)



Schmidt-Cassegrain Focuser

Manual version of JMI's famous
Zero-Image-Shift & NGF-S focuser

NGF-SE Manual Focuser

NGF-S for SCTs - This special version of our **NGF** focuser fits directly on to the 2" thread of Meade and Celestron 8"-14" Schmidt Cassegrain telescopes.

NGF-S w/built-in **MOTOFOCUS**

Includes: 2" -1.25" eyepiece and T-Thread adapter and 2" threaded output adapter. Optional Large-Format Adapter for 10"+SCTs

NGF-miniS 1.25" version (2" travel for SCTs)

\$169 (\$7)

\$269 (\$7)

\$45 (\$5)

\$229 (\$7)



MOTOFOCUS upgrade
for **NGF** Focusers
(Must be ordered together)

Dennis di Cicco
3/94 Sky & Telescope

\$100.00

NGF-DX1 2" with 1.25" adapter (lifts 12lb.) **\$259.00 (\$7)**
NGF-DX2 2" with 1.25" adapter (lifts 10lb.) **\$199.00 (\$7)**
NGF-DX3 2" with 1.25" adapter (lifts 5lb.) **\$159.00 (\$7)**
NGF-mini2 1.25" **\$129.00 (\$7)**
NGF-mini3 1.25" **\$99.00 (\$7)**
DRO (digital focusing) **\$229.00 (\$7)**
DFC **\$59.95 (\$7)**

MOTOFOCUS when ordered
with focuser **\$100.00 (N/A)**

MEGAWEDGE

• It holds the **ETX-90 Astro/EC-90**,
ETX-125, **NexStar 5**, **NexStar 8**.

• Fits **NexStar 5/8 tripod**
& **Meade field tripod**.

• **Now** - with polar sight tube
(folds away when not in use)

• Adjusts from zero to ninety latitude.

• Extremely easy to install with
JMI's exclusive slide-on mounting.

\$139
(\$11)

**Holds 6
eyepieces**



Work station can rotate 360°
as needed for convenient
observing. Holds four 2" and
1-1/4" eyepieces as well as
hand control.

Organizer/Work Station \$99 (\$7)

ORGANIZER/WORK STATION



Fits all Meade
scopes with standard
field tripod. (not 12")

8:00am to 5:30pm M-TH
8am to 4pm F (Mountain Time Zone).
Prices subject to change without notice.

ALL NEW DESIGN MOTOFOCUS

FOR **NEXSTAR 5" & 8" SCOPES**

Easy to install, smooth
operation clutch allows
manual or electric operation.

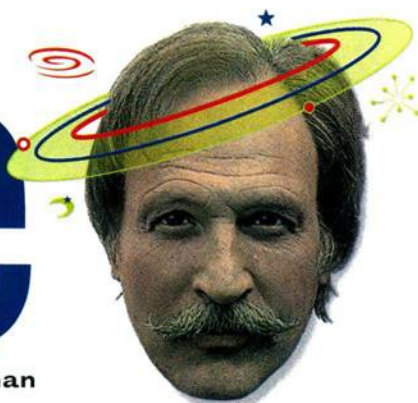
**MOTOFOCUS
for NEXSTAR 5" & 8"**

\$119.95 (\$6)



■ strange Universe

by Bob Berman



On the Christmas Star

These days, most educators know better than to mix religion and science. Yet this month, many planetaria will try to blend oil and water by presenting their annual “Star of Wonder” shows for the holidays. These shows attempt to offer astronomical explanations for the Christmas Star.

The topic never loses its fascination. Earlier this year *The New York Times* headlined the latest theory, now added to the large assortment most of us have already heard. The bright star that, according to Matthew, “Went before them, and stood above where the Christ child lay,” was really a comet. Another hypothesis suggests it was a conjunction of bright planets. Another suggests a supernova. Not so, claims this year’s theory; it was Jupiter in the constellation Aries.

In suggesting various possibilities, planetaria get to explain each of these celestial phenomena and how they appear. This way, science education is entertainingly woven into a Bible story. Is anything wrong with that?

Every backyard amateur knows that you just can’t get anywhere by following something in the sky. Whether it was a star or a comet that the Magi pursued is scarcely relevant because Earth’s rotation quickly makes everything in the heavens change position. All objects, whether planets or supernovae, rise in the east, arc rightward during the night into the south, and set in the west. You’d go in a giant semi-circle if you followed any kind of celestial object. What’s more, no astronomical body can come to a screeching halt over Bethlehem or any other place.

The only place in the sky where objects don’t move is in the north: Things hang motionless at the celestial pole. That eliminates planets, which are never in the north. Besides, the Magi weren’t going north to get to Bethlehem, but southwest. Bottom line: Not one scientific explanation can possibly be valid.

Many scholars believe that the star never really existed as a physical object. Rather, when the account was written 50 years after the crucifixion, the star was meant as an astrological omen. In those days, births of all great kings were accompanied by auspicious astrological configurations; presumably Jesus should have one as well. At that time, the sign of Aries was linked with Judea, and Jupiter was its ruling planet. The merging of those two, as occurred in the year 6 B.C. when some scholars tag the birth, would have been exactly the kind of prophetic omen that should accompany the coming of a Saviour.

Astrology eventually fell into total disfavor with both the church and science, so this explanation is popular with

neither, though it manages to get a brief mention at most planetarium Christmas presentations. Bringing up astrology, however, also suggests that astrologers were correct in foreseeing the birth. Such tacit support for pseudoscience is the last thing educators or religious leaders want to impart.

On the other hand, sticking with strictly astronomical explanations (conjunction, supernova, comet) is deceptive since the public is presented with hypotheses astronomers know to be false, and the disclaimer is often omitted. When I interviewed several planetarium directors, a common thread emerged. Yes, they all know the “Star of Wonder” show is scientifically inaccurate. Yes, many are uncomfortable with it. But it’s been running continuously since the 1930s when the first one was introduced and has become a tradition in its own right. The public keeps coming, and, as one director explained, “We’re just giving them what they want.”

Some readers will write me angry letters because they think I’m disparaging the biblical account. Save your postage, this has nothing to do with religious faith. Those who believe the Magi were led by an actual star are free to maintain that view. After all, most planetaria explanations already are nearly indistinguishable from miracles. It seems pointless to introduce a scientific “explanation” that has to unfold outside the laws of science.

To me, the silver lining in this annual December exercise is a marvelous confirmation of why science and religion make strange bedfellows. Their marriage often produces odd offspring, and in this case it’s twins: a planetarium show with wildly erroneous astronomy plus the implication that faith in the miraculous is unneeded because there’s a logical explanation. Both religion and science are poorly served.

But the shows will continue, and newspapers will continue to report other scientific explanations for the Christmas Star. Personally, I’ve always regarded the brightest star in the heavens each December 25 as that year’s Christmas star. This time it’s Venus, so beautifully dazzling in the southwest on Christmas Eve. It hovers in the very direction the Magi were traveling.

In my hometown in the snowy mountains of upstate New York, nearly the whole village — all faiths — come out for Christmas caroling. If it’s clear that night, the Evening Star should perfectly complete that storybook tapestry. Anyone seeking a brilliant portent on this dawn of the new millennium couldn’t do much better than the Christmas Star of the year 2000.

A

PRECISION SOLAR FILTERS



Recognized around the world for product quality and cutting edge advances, our filters are the preferred choice of telescope retailers and used exclusively by NASA aboard the Space Shuttle. Other professional users include: ABC, BBC, CBS, NBC, CNN, NOVA, The Discovery Channel, National Geographic and most major universities and observatories. Tens of thousands are in use world wide.

TYPE 2+ - Made with high quality hand select glass and coated with our exclusive Solar II Plus. The most durable filter on the market. Transmission is 1/1,000th of 1%. (OD-5). Great for both visual and photographic use. Solar image is yellow-orange. Guaranteed 15 yrs.

TYPE 3+ - Lighter density, 1/100th of 1% (OD-4) for maintaining fast shutter speeds when using 'slow' fine grain films. For photographic use only. Solar image is yellow-orange. Guaranteed 15 yrs.

POLYMER PLUS - Exclusive *Thousand Oaks Optical* polymer filters offer high resolution at an economical price. Unlike aluminized Mylar, solar image is yellow with better resolution and contrast. Coated on two sides with our exclusive Solar II Plus. Image quality and resolution equals our glass. Guaranteed 10 years.

	TYPE 2+ or 3+		POLYMER PLUS	
APERTURE	Full Aper.	Off-Axis	Full Aper.	Off-Axis
2.4" to 3.1"	\$ 69.00	N/A	\$ 49.00	N/A
3.5" to 4"	79.00	N/A	59.00	N/A
4.25" to 5"	99.00	N/A	69.00	N/A
6"	109.00	\$ 79.00	\$ 79.00	\$ 69.00
7" to 8"	129.00	89.00	89.00	79.00
10"	149.00	109.00	N/A	89.00
11"	159.00	119.00	N/A	99.00
12" to 13.1"	179.00	139.00	N/A	119.00
14"	199.00	149.00	N/A	139.00
40-80mm Binoc	129.00 pr	N/A	89.00 pr	N/A

NEBULAR FILTERS - Enhance your deep sky viewing with the latest in multilayer coating technology. Our filters transmit desired wavelengths in a very steep slope vs. gentle transition slopes in competitive brands. This means better contrast and overall performance. Made in the U.S. 1.25" - \$89 Ea., 2" - \$179 Ea.

LP-1 (Broadband) For slight to moderately light-polluted areas.

LP-2 (Narrowband) For heavily light-polluted areas.

LP-3 (Oxygen III) For diffuse and planetary nebulae.

LP-4 (H-Beta) For Horsehead, Calif., & other faint nebulae.

SOLAR ECLIPSE VIEWERS & FILMS - We manufacture a complete line of eclipse viewing devices and thin films including Mylar & our exclusive 'Black Polymer.'

Payment may be made by personal check, bank check or money order. We also accept Visa, MC & AMX. Free brochure available or visit our web site.

THOUSAND OAKS OPTICAL

BOX 4813-A, THOUSAND OAKS, CA. 91359

TOLL FREE ORDER LINE: 800-996-9111

INFORMATION LINE: 805-491-3642

Phone Hours: 10:00 - 5:00 Pacific - Mon-Fri

FAX: 805-491-2393 (24 hours)

www.thousandoaksoptical.com

"The Edmund Astroscan... features ...'out-of-the-box' ease of use and transport. ...time-tested design is superior, ...it's far better optics give respectable views of highlights like Jupiter's bands and Saturn's rings when mated with an optional 8 to 10mm eyepiece. ...will keep a budding stargazer going for many months without having to purchase other atlases or catalogs."

by Joshua Roth - Sky & Telescope, March 2000

REACH OUT AND EXPLORE THE NIGHT SKY
WITH OUR FAMOUS, AWARD WINNING

ASTROSCAN® WIDE-FIELD TELESCOPE 2001

The ideal first telescope for your entire family!

Unique award-winning compact design allows you to cradle the Astroscan® in your arms or glide it smoothly in its table-top base. Highlights of this scope are its extra wide 3° field and its superb light-gathering ability with a large 4 1/8" clear aperture to resolve panoramic vistas. An optional image erector enables this versatile scope to view land objects.

Telescope Package #AF02-001 for only \$299.00 includes:

- Astroscan® 2001 Telescope
- Instrument-Quality 28mm RKE® Eyepiece
- Padded Table-Top Base
- Open Sight Target Finder
- Dust Cap and Carry Strap
- 36 Page Users Manual
- 5 Year ES Limited Warranty
- 40 Page "Sky Guide"

New 100 page color catalog has a wide assortment of telescope accessories and scientific products for the entire family.

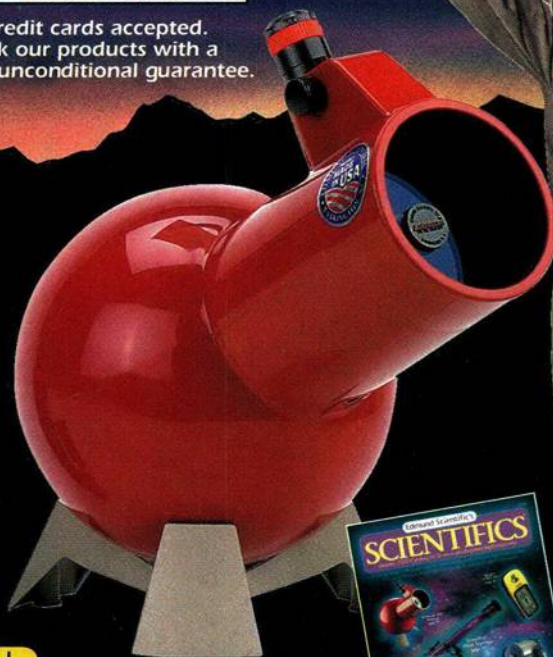
Order online or call today toll free.

FREE CATALOG

800-728-6999

www.scientificsonline.com

Major credit cards accepted.
We back our products with a
30 day unconditional guarantee.



Edmund Scientific Co.

CONSUMER SCIENCE DIVISION

Dept. D011-C821, 101 East Gloucester Pike, Barrington, NJ 08007-1380

Tel: 856-547-3488 • Fax: 856-547-4826 • E-mail: cons_order@edsci.com

© Scientifics and Astroscan are registered names of the Edmund Scientific Company

LUMICON® High Performance

WWW.LUMICON.COM

Visit our San Francisco Bay Area Showroom M-F 9-7, Sat 10-3



Two BIG items from the NexStar Family

First: The price of the NexStar 8 has DROPPED to \$1,699. Second: Celestron has added 3 new beginner sized telescopes to the NexStar family

NexStar 60 GT	
60mm f/12 refractor w Go-To Mount	\$299
NexStar 80 GT	
80mm f/5 refractor w Go-To Mount	\$399
NexStar 114 GT	
114mm f/9 Newtonian w Go-To Mount	\$499

Other Celestron Telescopes at Lumicon

NexStar 5	\$1199
Ultima 2000	\$2699
Celestar Deluxe	\$1699
Celestar	\$1099
CM 1100-11" SCT	\$3199
Starhopper 8" Dob	\$429
Starhopper 6" Dob	\$339
C102HD 4" Refractor	\$549
FirstScope 114	\$299
CRI 50 6" f/8 Refractor (NEW!)	\$799

At Last!! Advanced Santa Barbara Instruments CCDs available thru Lumicon . . . the experts in astrophotography!



Lumicon is proud to announce that we are now an authorized dealer for quality Santa Barbara Instruments CCD cameras and accessories. Here is just a sample of what is available.

ST-4 , Auto Guider 192x 164 pixels	\$890
ST-237 , Imager 640 x 480 pixels	\$1195
ST-5C , Imager 320 x 240 pixels	\$895
ST-6B , Imager 375x241 (large) pixels	\$3025
STV Video Camera Deluxe	\$1995

And much, much more!!! Call Lumicon, the experts in astrophotography, for all of your CCD needs.

LUMICON FILTERS - BEST IN THE WORLD BUT WHICH FILTER TO BUY?



Lumicon Deep Sky Filters follow the classic broad band curve but offer the highest transmission of nebula lines of any such filter available. Lumicon Deep Sky filters block mercury and sodium vapor lamp emissions while letting thru all other parts of the spectrum. Deep Sky Filters are most useful for astrophotography (color & b&w) and CCD work. Deep Sky Filters are also useful visually, nebula offering the best contrast gain but galaxies, star clusters and dusty comets are also slightly enhanced.

1.25" Deep Sky Filter (fits most 1.25" eyepieces)	\$99.50
48mm Deep Sky Filter (fits 2" eyepieces and Lumicon accessories)	\$199.50
Visual Back Deep Sky Filter (fits in series on back threads of SCTs)	\$199.50
2" Deep Sky Filter (fits 2" eyepieces and T-threaded accessories)	\$199.50
72mm Deep Sky Filter (for the front of large telephoto lenses*)	\$399.50

*step rings for other sizes available.

Lumicon Ultra High Contrast Filters have a narrow band pass that lets thru the two oxygen III and the hydrogen beta lines while blocking the remaining visual spectrum. The resulting filter yields high contrast views of all types of nebula. It is best used visually with any telescope of f/6 or longer focal ratio. The Ultra High Contrast Filter is not for photography.

1.25" Ultra High Contrast Filter (fits most 1.25" eyepieces)	\$99.50
48mm Ultra High Contrast Filter (fits 2" eyepieces and Lumicon accessories)	\$199.50
Visual Back Ultra High Contrast Filter (fits in series on back threads of SCTs)	\$199.50

Lumicon Oxygen III filters isolate just the two oxygen III lines of the spectrum and block the remaining visual spectrum. The Oxygen III filter yields the maximum contrast gain possible on planetary nebula and most emission nebula. Views of the Veil Nebula and others with this filter are beyond words. The Lumicon Oxygen III Filter is for visual use only and is best suited for 6" and larger aperture telescopes with focal ratio of f/10 or faster.

1.25" Oxygen III Filter (fits most 1.25" eyepieces)	\$99.50
48mm Oxygen III Filter (fits 2" eyepieces and Lumicon accessories)	\$199.50
Visual Back Oxygen III Filter (fits in series on back threads of SCTs)	\$199.50

Lumicon Hydrogen Beta Filters isolate just the hydrogen beta line of the spectrum and block the remaining visual spectrum. The Hydrogen Beta filter was created with a select number of low energy nebula in mind such as the Horsehead, Cocoon & the California nebula. In many instances the Hydrogen Beta filter is the **ONLY** way to see these nebula. The Hydrogen Beta Filter is a visual filter only, best suited to 8" or larger aperture telescopes with focal ratios of f/5 or faster.

1.25" Hydrogen Beta Filter (fits most 1.25" eyepieces)	\$99.50
48mm Hydrogen Beta Filter (fits 2" eyepieces and Lumicon accessories)	\$199.50
Visual Back Hydrogen Beta Filter (fits in series on back threads of SCTs)	\$199.50

Special Pricing - Buy two or more Lumicon filters and get a DISCOUNT.

Filters normally priced at \$99.50	pay only \$92.50
Filters normally priced at \$199.50	pay only \$185.00

SKY VECTOR™ \$349!!! Includes Computer, Encoders, Hardware

LUMICON Sky Vector Features:

- "GUIDE" mode leads you to object
- Digital right ascension readout to 1 min.
- Digital declination reading to 10 arc/min.
- 4000 pulse (0.09 accuracy) encoders
- Polar Alignment NOT REQUIRED!
- Motor drive NOT REQUIRED!
- Just two stars to align
- Works Equally well for alt-azimuth telescopes like Coulter Odyssey and equatorial mounts like C-8, Meade 2080.
- No need to enter latitude, longitude etc.

SKY VECTOR™ \$349.00

NEW! With over 220 object memory including the 110 Messier and 58 best NGC objects.

NGC-SKY VECTOR™ \$489.00

12,000 objects! PC serial port NGC Sky Vector with IDENTIFY (Sky Tour) mode; 12,000 object memory including the corrected RING catalogue, IC catalogue, P&K planetary catalogue and much more.



Specify Telescope Type: Meade 4", 8", 10", 12" SCT, C-8, C-11, Odyssey 8", 10", 12", 17 1/2" alt-azimuth; Meade 6"-16" Dobsonian; Ultima 8", 9 1/4", 11" add \$25. C-14 add \$75.

TELE VUE PRODUCTS



4X Powermate for 2" eyepieces	\$265
5X Powermate boosts magnification 5x	\$168
Ranger 70mm f6.8 apochromat w/1 1/4" diag.	\$695
Pronto 70mm f6.8 w/1 1/4" diagonal	\$945
Tele Vue 85,85mm f/7 APO telescope	\$1995
Bino Vue binocular w/2x correc.	\$1030
Gibraltar mount with ash wood tripod	\$530
8,11,15mm Plossl	\$82 — 20,25mm \$95
32mm Plossl , widest true field in 1 1/4"	\$110
55mm Plossl , widest possible field	\$230
2.0x or 3.0x Tele Vue Barlow Lens	\$105
2" Giant Barlow - 2x	\$168
4.8mm Nagler 82° field, 1 1/4" eyepiece	\$175
7mm Nagler , 1 1/4" eyepiece, 82° field	\$220
9mm Nagler , 82° field 1 1/4" or 2"	\$240
12mm Nagler Type 4 , 82° 1 1/4" or 2"	\$340
16mm Nagler Type II , 82° 1 1/4" or 2"	\$310
17mm Nagler Type 4 , 82° 2" only	\$370
22mm Nagler Type 4 , 82° 2" only	\$445
31mm Nagler Type 5 , 82° 2" only	\$595
2" Paracorr visual coma corrector	\$235
3,4,6,8,10,14mm Radian , 60° field	\$228
15mm Panoptic 1 1/4", 68° field	\$210
19mm Panoptic 1 1/4", 68° field	\$240
22mm Panoptic 1 1/4"/2", 68° field	\$280
27mm Panoptic 2" , 68° field	\$330
35mm Panoptic 2" , 68° field	\$365
NEW! Tele Vue 18mm radian , 60° field	\$228

Note: Tele Vue warranty may not be valid outside USA



Lumicon, always in the forefront bringing you the latest scopes and specials, brings you the newest scope from Tele Vue. The Tele Vue 102 (shown with optional Gibraltar Mount) brings you the best of apochromatic optics in a longer 880mm f/8.6 length making it and even better choice for planetary viewing than previous releases.

Tele Vue 102 tube assembly only	\$2050
Tele Vue tube holder for 102	\$120
Tele Vue Ash Gibraltar Mount	\$530
Lumicon 2" Enhanced Aluminum Star Diagonal	\$189.50
Lumicon 2" 1.25" Reducer	\$25

We are Takahashi dealers Call for lowest prices!

LUMICON

6242 Preston Avenue, Livermore, CA 94550

Phone Orders: Call our toll free ORDER LINE: 1-800-767-9576
EXPERT Information and Catalog Requests: Call 1-925-447-9570
FAX 1-925-447-9589 ▪ Prices subject to change without notice
In stock items shipped within 2 business days

LUMICON®

Telescopes and Accessories

6242 Preston Avenue
Livermore CA 94550

Phone hours: M-F 9AM/7PM pst
Sat. 10AM/3PM pst 1-925-447-9570

ORDER TOLL FREE
1-800-767-9576

LUMICON Now Bigger, More Modern Than Ever

Anyone from San Francisco to Reno, Redding to Bakersfield is invited to visit our new, spacious facilities at 6242 Preston Avenue in Livermore, CA!

Lumicon has doubled its size and tripled its showroom space - providing a huge selection of Telescopes, Binoculars, Spotting Scopes and related optical accessories right on the floor. . . And our inventory is growing all the time.

Even our hours are "bigger"
The showroom is now open until 7 p.m. weekdays
and 3 p.m. on Saturdays

Give us a call for directions. We're just two blocks off US 580

PENTAX EYEPIECES

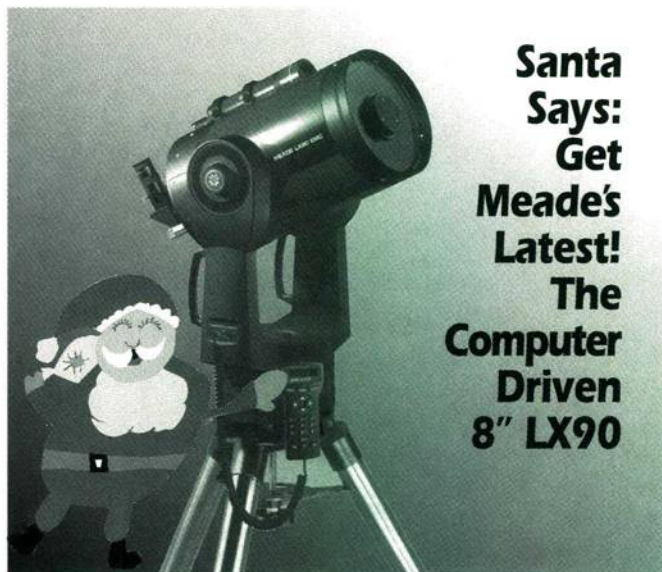


Great Prices! Pentax 65°XL

Amazing performance! All have 20mm eye relief, adjustable helical eye guard, super multi-coatings, E.D. Glass

5.2mm F.L., 65° Apparent Field 1 1/4"	\$279
7mm F.L., 65° Apparent Field 1 1/4"	\$279
10.5mm F.L., 65° Apparent Field 1 1/4"	\$269
14mm F.L., 65° Apparent Field 1 1/4"	\$269
21mm F.L., 65° Apparent Field 1 1/4"	\$269
28mm F.L., 55° Apparent Field 1 1/4"	\$259
40mm F.L., 65° Apparent Field 2"	\$299

Pentax Binoculars Spectacular 20mm eye relief	
5x40mm Pentax PCFV Binocular	\$169
7x50mm Pentax PCFV Binocular	\$169
10x50mm Pentax PCFV Binocular	\$184
16x60mm Pentax PCFV Binocular	\$249



**Santa
Says:
Get
Meade's
Latest!
The
Computer
Driven
8" LX90**

THE SCOPE REVOLUTION CONTINUES

Meade engineers have come out with their latest entry in the computer driven telescope revolution. The 8" LX90 combines Meade's proven optics with a dual metal fork arm mount and Autostar technology to produce a low priced, fully capable alternative. Both axis have a 4.9" worm drive for smooth motion. The 8" LX90 comes with the same tripod as the LX200. All for a low \$1695 (plus \$95 shipping)

Other Fine Meade Telescopes at Lumicon

8" LX200 SCT with Tripod (\$105p/s)	\$2295
10" LX200 SCT with Tripod (\$145p/s)	\$2695
12" LX200 SCT with Tripod (\$215p/s)	\$3995
Wedge for 8" LX200 (for photography) (\$15p/s)	\$139
Superwedge for 10"/12" LX200 (\$35p/s)	\$395
8" LXD500 w/German eq. mt. (\$65 p/s)	\$895
8" LX10 SCT w/RA drive (\$65 p/s)	\$995
ETX 90EC Maksutov w/std. drives (\$20p/s)	\$595
ETX125EC Maksutov w/std. drives (\$30p/s)	\$895
DS80 EC w/dual drives (\$45p/s)	\$449
DS90 EC w/dual drives (\$50 p/s)	\$499
DS114EC w/dual drives (\$45 p/s)	\$399
DS127ED w/dual drives (\$50 p/s)	\$499

Meade Starfinders 6-16"

6"f/8 Dobsonian Starfinder (\$46P&S)	\$249
6"f/8 Equatorial Starfinder (\$79 P&S)	\$499
8"f/6 Dobsonian Starfinder (\$59P&S)	\$349
8"f/6 Equatorial Starfinder (\$89 P&S)	\$599
10"f/4.5 Dobsonian Starfinder (\$85 P&S)	\$449
10"f/4.5 Equatorial Starfinder (\$99 P&S)	\$699
12.5"f/4.8 Dobsonian Starfinder (\$95 P&S)	\$795
16"f/4.5 Dobsonian Starfinder (fr. cod.)	\$1195
16"f/4.5 Equatorial Starfinder (fr. cod.)	\$2695

*All Starfinder telescopes shipped directly from Meade to the purchaser. Please add the indicated packing and shipping charge to the price. Slightly lower P&S for payment by check. Lumicon showroom prices are \$50 to \$100 higher.

See the Meade ad in this magazine for full descriptions. Starfinders are complete telescope systems with motor drive and finderscope (Equatorial only) and 25mm (48x) eyepiece. New DC motor runs on four AA batteries.

Happy Holidays from all of us at Lumicon Have a bright, clear Christmas with these HOLIDAY SPECIALS



Lumicon Cassegrain Easy Guider for 5" thru 9.25" SCTs: \$219 (save \$30). Simply the best off-axis guider on the market. Specify which telescope and camera you will be using.



Lumicon 80mm Straight-Thru Super Finder w/ NEW 10X Plossl Cross-Hair Eyepiece: \$199 (save \$40). Lumicon 80mm Super Finder with 90 Degree Erect Image Prism and 10X Plossl Cross-Hair Eyepiece: \$239 (save \$40).



Purchase all four Lumicon filters at regular price of \$398 and receive a Lumicon 5x Filter Selector (A \$99.50 value) absolutely free!



Lumicon 1.25" Enhanced Aluminum Star Diagonal: \$89 (save \$10). Lumicon 2" Enhanced Aluminum Star Diagonal: \$169 (save \$20). Improves clarity and brightness on most SCT and Refractor Telescopes

Special Holiday Prices in effect Nov. 1 thru Dec. 23, 2000

Want to see Lumicon products first hand?
Visit these fine Lumicon retailers.
They will be happy to explain the
benefits of Lumicon accessories.

F.C. Meichsner Co., Inc.
182 Lincoln Street
Boston, MA 02111
1-800-321 VIEW (8439)

Shutan Camera & Video
Vernon Hills, Illinois
1-800-621-2248

Scope City
For nearest Scope City Store, call
1-805-5226646

ORION

TELESCOPES & BINOCULARS

TELESCOPES

Hundreds more products online!
telescope.com



Orion SkyQuest™ XT Dobsonian Telescopes

Big Aperture, Superior Performance, Point-and-View Simplicity

For a fraction of the cost of a little "go to" scope, you can own a telescope with serious aperture. See more of the universe—for less—with an award-winning SkyQuest XT metal-tube Dobsonian. It'll keep you up at night.



SkyQuest XT4.5

Just the right size for younger stargazers, and incredibly easy to master! Adults will love it too, for its portability and crisp optical performance.

Steel tube, 114mm mirror (f.l. 910mm, f/8), 1.25" R&P focuser, 6x30 achromatic finder scope, 25mm (36x) and 9mm (110x) Plössl eyepieces (1.25"), 5" flanged altitude hubs, CorrectTension Friction Optimization, built-in handle, dust cap. Weight: tube 9 lbs., base 8-1/2 lbs.

\$199

SkyQuest XT6

The overachieving XT6 will show Jupiter's Red Spot, Saturn's Cassini Division, hundreds of clusters and nebulae, and galaxies tens of millions of light-years distant. Nicely portable and very affordable!

Steel tube, 152mm parabolic mirror (f.l. 1200mm, f/8), 1.25" aluminum R&P focuser, 6x30 achromatic finder scope, 25mm (48x) and 9mm (133x) Plössl eyepieces (1.25"), Moon filter, eyepiece rack, 5" flanged altitude hubs, CorrectTension Friction Optimization, dust cap. Weight: tube 13 lbs., base 24 lbs.

\$369

SkyQuest XT8

The XT8's prodigious performance on both solar system and deep-sky denizens have made it the telescope of choice for thousands of astronomers, from beginners to die-hard hobbyists.

Steel tube, 200mm parabolic mirror (f.l. 1200mm, f/6), 1.25" aluminum R&P focuser, 6x30 achromatic finder scope, 25mm (48x) and 9mm (133x) Plössl eyepieces (1.25"), Moon filter, eyepiece rack, 5" flanged altitude hubs, CorrectTension Friction Optimization, dust cap. Weight: tube 19 lbs., base 23 lbs.

\$499

SkyQuest XT10

Gulping in over 50% more light than an 8" scope, the XT10 reaches far deeper into space. The sheer number of objects visible in this scope is staggering, and its resolving power brings out detail that will keep you entranced for years.

Steel tube, 250mm parabolic mirror (f.l. 1255mm, f/5), 2" aluminum R&P focuser, big 8x50 achromatic finder scope, 25mm (50x) and 9mm (139x) Plössl eyepieces (1.25"), Moon filter, eyepiece rack, 5" flanged altitude hubs, CorrectTension Friction Optimization, dust cap. Weight: tube 35 lbs., base 23 lbs.

\$649

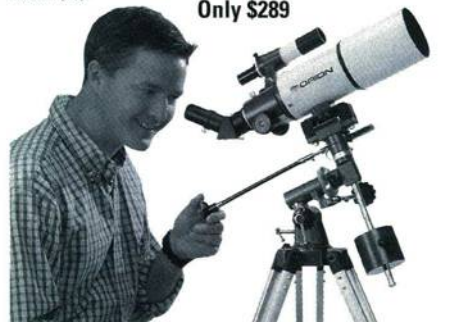
**ENAMELED STEEL TUBE,
NOT CARDBOARD!**

New!

Orion ShortTube™ 80mm EQ

Our popular ST80 is now available in a portable equatorial package. Super easy to set up, carry, and operate. Its 80mm aperture serves up bright, expansive gulps of sky. The EQ-1 equatorial mount has manual slow-motion controls and accepts an optional EQ-1M electronic drive. Adjustable aluminum tripod with accessory tray. Accessories include a 6x26 correct-image finder scope, correct-image 45° diagonal, and two Explorer II eyepieces (1.25"): 25mm (16x) and 10mm (40x). Comes with 1/4"-20 adapter for coupling tube assembly to mount. Focal length 400mm (f/5).

Only \$289



Orion Skywatcher 90mm EQ Refractor

Enjoy clear, sharp images of the Moon, planets, double stars, and bright deep-sky

showpieces for only \$339 complete. Multi-coated, 90mm achromatic objective lens (910mm focal length, f/10) in all-aluminum tube. Includes the sturdy EQ-2 mount, which accepts an optional electronic drive. Also comes with a 6x30 finder, mirror star diagonal, 25mm (36x) and 10mm (91x) Kellner eyepieces (1.25"), and aluminum tripod with accessory tray.

Was \$359 Now \$339



**New
Lower
Price!**

Orion SkyView™ Deluxe EQ Series

Telescopes for Today's Amateur Astronomer

SkyView™ Deluxe 8 EQ Newtonian

A deep-sky lover's delight! Big, diffraction-limited 200mm parabolic primary mirror of 800mm focal length (f/4) delivers vivid, wide-field views of nebulae, clusters, and galaxies. Gathers 73% more light than a 6" scope, yet is nicely portable. Enamelled steel tube and aluminum R&P focuser (1.25").

\$649

SkyView™ Deluxe 6 EQ Newtonian

Outstanding for deep-sky and planetary/lunar study. Features a precision 6"-diameter parabolic primary mirror and aluminum R&P focuser. Enamelled steel optical tube. Focal length 750mm (f/5).

New Lower Price! Was \$529 Now \$499

SkyView™ Deluxe 4.5 EQ Newtonian

An exquisite combination of form, function, and affordability for the serious beginning astronomer. The rolled steel optical tube houses a precision-polished 4.5" primary mirror of 920mm focal length (f/8).

\$388

SkyView™ Deluxe 90mm EQ Refractor

Exceptionally crisp views of the Moon, planets, and beyond! Multi-coated 90mm achromatic objective lens of 1000mm focal length (f/11.1). Seamless aluminum optical tube.

New Lower Price! Was \$449 Now \$399



**Electronic Drive
Compatible!**

Look What's Included

- New heavy-duty EQ mount
- TWO 1.25" Plössl eyepieces
- 6x30 achromatic finder scope
- Moon filter (1.25")
- Gold-anodized aluminum tripod

FREE!

A \$49.95 Value!
Polar-Alignment Scope

Outfit your SkyView Deluxe with an AccuTrack™ Electronic Drive for automatic star tracking.

Now \$77



Visit one of our California Retail Stores!

San Francisco • 3609 Buchanan St., at Bay, 1 block from Marina Safeway • (415) 931-9966

San Jose-Cupertino • 10555 S. De Anza Blvd., at McClellen: from Hwy 280, take De Anza exit; from Hwy 85 take De Anza or Stevens Creek exit • (408) 255-8770

Prices are subject to correction or change without notice.

24 Hour Toll-Free Orders: (800) 447-1001
Information/Advice: (800) 676-1343

Information Line Hours: M-F 6am-8pm, Sat. 8am-6pm Pacific Time

telescope.com

BINOCULARS



**New
Lower
Price!**



**FULLY
MULTI-COATED
OPTICS!**



LONG EYE RELIEF!



**TRIPOD
L-ADAPTER
INCLUDED!**



Scenix™ 50mm

Newly upgraded with BAK-4 prisms for improved images. Multi-coated optics. Metal housing, not plastic. Tripod adaptable. Terrific price! Great gift.

7x50 7.1° field \$77.50
10x50 WA 7.0° field \$77.50

UltraView™ 50mm

Extra-long 22mm eye relief makes these superb for eyeglass wearers! Fully multi-coated optics, BAK-4 prisms. New twist-lock eyecups. Tripod adaptable.

7x50 6.5° field Was \$169 **\$159**
10x50 WA 6.5° field Was \$169 **\$159**

Vista™ 50mm

Featherlight High-Performance Binoculars. High-index BAK-4 prisms and fully multi-coated optics for high-fidelity images. Soft leatherette covering. Tripod adaptable.

7x50 6.0° field Was \$219 **\$179**
10x50 WA 5.3° field Was \$219 **\$179**

Mini Giant™ Binos

Compact astro binocs that show you the light! Fully multi-coated optics, BAK-4 prisms. Long eye relief (8x56: 18mm, 9x63: 26mm). Easily hand-holdable, but also tripod adaptable.

8x56 5.8° field Was \$149 **\$129**
9x63 5.0° field Was \$199 **\$179**

Giant 80mm

Stunning resolution of clusters, nebulas, and lunar surface detail. Fully multi-coated optics with BAK-4 prisms. Objective bridge for added rigidity. Center focus. Tripod L-adapter included. Long 15mm-16mm eye relief.

11x80 4.5° field Was \$399 **\$388**
16x80 3.5° field Was \$399 **\$388**
20x80 3.5° field Was \$399 **\$388**



**Sale!
Save \$20**

Little Giant™ II 70mm Binocular

More compact than the original Little Giants. Big 70mm objectives reveal a plethora of nebulous clouds and stellar clusterings. Great for twilight and daytime use too. Sharp, fully multi-coated optics with BAK-4 prisms. Large, knurled center focus wheel. Classic black coarse-grain finish. Tripod L-adapter, case, and deluxe wide neck strap included. Made in Japan.

11x70 4.5° field Was \$259 **\$239**
15x70 4.0° field Was \$259 **\$239**
20x70 3.0° field Was \$259 **\$239**

**TRIPOD
L-ADAPTER
INCLUDED!**

SuperGiant™ 25x100mm

Gigantic 100mm (almost 4") lenses for unbelievably detailed views of the heavens at 25x! Multi-coated optics with BAK-4 prisms. Center focus. 2.6° field of view. Platform-type 1/4"-20 mounting plate included. Comes with foam-lined aluminum case.

\$1149



80mm Binocular Telescope

An unforgettable visual experience! Uses interchangeable 1.25" telescope eyepieces, allowing wide range of powers! Includes two 25mm eyepieces (36x, 1.1° field). Mount/tripod sold separately.

Was \$999 **\$899**

Custom D Altaz
Mount/Tripod
Shown here.

\$449



**INTERCHANGEABLE
EYEPIECES!**

EYEPIECES & ACCESSORIES



Sirius™ Plossl Eyepieces

You could pay twice the price for other brands of Plossl eyepieces, but why? Sirius Plossls are top-quality, 50° apparent-field (43° 40mm) eyepieces that yield extremely sharp images of impressively high contrast. Ideal for all types of telescopes. Fully-coated optics, rubber eyeguards.

1.25"
6.3mm, 7.5mm, 10mm, 12.5mm, 17mm,
20mm, 26mm **\$49.95 each**
32mm, 40mm **\$59.95 each**
.965"
6.3mm, 7.5mm, 10mm, 12.5mm, 17mm,
20mm, 26mm **\$49.95 each**

Save Big on Sirius Sets! Need More Than One?

Save on these practical Sirius Plossl sets. (You save on shipping, too!) 1.25" barrel diameter only.

Sirius Plossl Starter Set

And ideal "upgrade" set to replace lower-quality eyepieces, it includes three must-have focal lengths for low-, medium-, and high-power viewing: 26mm, 17mm, and 10mm.

Reg. \$149 Set Price **\$119**

Sirius Plossl Expansion Set

If you already have the Starter Set, or the 25mm and 10mm eyepieces included with many telescopes, this set provides three complementary focal lengths for medium and high magnifications: 20mm, 12.5mm, 7.5mm.

Reg. \$149 Set Price **\$119**

Sirius Plossl Power Pair

For planetary and lunar viewing especially, these 12.5mm and 7.5mm high-power eyepieces will have you discovering new detail. Even if you already use a 9mm or 10mm eyepiece, get this pair to add more magnification options.

Reg. \$100 Set Price **\$79.90**



Padded Scope Cases

Protect your investment with a padded, polyester/nylon case. Strap handles for easy carrying. Many sizes.

From \$29.95



Aluminum Accessory Cases

Rugged and classy looking. Pre-cut, cubed foam inside to fit your specific accessories. Ample room for giant eyepieces, camera body, lots of stuff! Medium Case Was \$34.95 **\$29.95**
Large Case Was \$49.95 **\$44.95**



Orion Solar Filters

Catch this year's intense sunspot activity with a safe, full-aperture glass solar filter for your telescope. Sizes to fit many telescopes.

From \$54.95



Orion EZ Finder™

Illuminated "red dot" in nonmagnified 9° field of view shows right where telescope is pointed. Adjustable brightness. Attaches to any telescope.

\$39.95



Orion LaserMate™ Collimator

Align your Newtonian's optics to get the best possible images. This compact laser collimator removes the guesswork, making the procedure quick and extremely precise. Just 3-1/3" long!

Only \$64.95



SkyGlow™ Broadband LP Filters

Improves contrast of all objects in moderately light-polluted skies.

.965" **\$44.95**
1.25" **\$59.95**
2" **\$109**, SCT Rear Cell **\$89.95**
UltraBlock™ LP Filters
Maximum contrast enhancement for emission nebulas.
.965" **\$79.95**, 1.25" **\$99.95**
2" **\$139**, SCT Rear Cell **\$129**

Orion Lanthanum

Eyepieces

Our rare-earth lanthanum eyepieces have new chrome exteriors but the same superior image correction and generous 20mm eye relief of the previous models. Ideal for eyeglass wearers!

Fully multi-coated optics with six to eight lens elements. Apparent field 50° (7.5-25mm), 45° (2.3mm-5.2mm). Pop-down rubber eyecups. Made in Japan. 1.25" barrels.

3.8mm, 5.2mm, 7.5mm, 9.5mm, 10.5mm, 12.5mm, 14mm

2.3mm, 18mm, 21mm, 25mm

\$109 each

\$119 each



Lanthanum 65° Superwides

Combining long 20mm eye relief, an expansive 65° apparent field, and a rare-earth lanthanum lens element for superior image correction, these oculars are an astronomer's dream come true. Eight lens elements, multi-coated. Fit 1.25" or 2" focusers.

3.5mm, 5mm, 8mm, 13mm **\$214 each**

17mm, 22mm **\$222 each**

NEW! 42mm (2" only) **\$319**

ORION
TELESCOPES & BINOCULARS
P.O. BOX 1815-A, SANTA CRUZ, CA 95061

telescope.com

IT'S EASY TO ORDER!

- Call toll-free and charge to your Discover/Novus, MasterCard, or VISA Card, or send your personal check to order by mail. Mail Orders to: P. O. Box 1815-A, Santa Cruz, CA 95061-1815. Fax Orders to: (831) 763-7024.
- California residents add 7.25% sales tax (8.25% in Santa Clara County; 8% in Santa Cruz County; 8.5% in San Francisco).
- Shipping and handling charges additional. Call for rates. Delivery in U.S. and Canada only. Expedited delivery available.
- Prices are subject to correction or change without notice.

FREE 100-PAGE CATALOG
CALL (800) 447-1001



When ordering, mention key code TMA





A PRODUCTS

Celestial Harvest: 300-Plus Showpieces of the Heavens for Telescope Viewing and Contemplation

► This 103-page spiral-bound observing manual covers solar-system objects and deep-sky attractions that are visible in telescopes with apertures ranging from 2 to 14 inches. Jim Mullaney, creator of the manual, calls it his "40-year labor of love."

The manual is a sequel to *The Finest*

**Total Solar Eclipse**

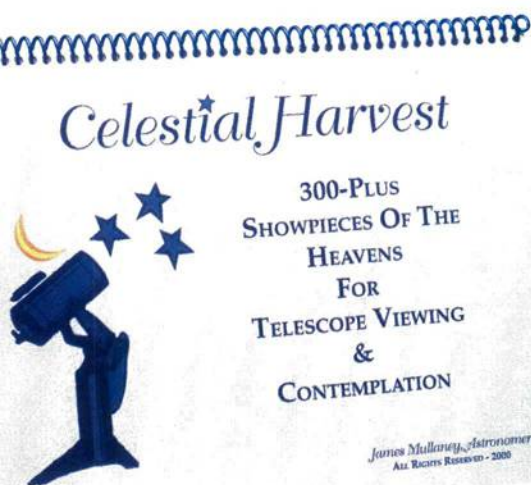
► Eclipse cruisers may have seen it and heard it flap. Those who attended "Astrocon 2000," the 54th annual convention of the Astronomical League, saw it under California's July sun. It is Kandra Kargo's "Total Solar Eclipse" flag. Under the business banner of Teapot Sagittarius, Kargo sells the navy, light blue, white, and black flag as well as other flags with astronomical designs.

The 36-inch by 60-inch flag fabric is a "nylon glow" synthetic made for outdoor use. Kargo designed the flag to be hung vertically as a banner or horizontally from a flagpole. Each flag has a

pole pocket on one side for decorator-pole use.

Some of Kargo's unique designs are on display in observatories and science centers around the United States. Her "Our Saturn from Hubble" and "The Supernova '87" flags were exhibited at the Planetary Society's Planetfest '97, a show during JPL's Mars Pathfinder landing festivities.

Teapot Sagittarius, P.O. Box 5315, Fullerton, CA 92835; phone, (714) 680-3751; e-mail, ceramic1@flash.net. \$50 includes tax, shipping, and handling.



Deep-Sky Objects, which Mullaney first published 34 years ago. *Celestial Harvest* contains basic observational data, observing techniques, and thousands of descriptions recorded by famous and less-well-known observers during the past three centuries.

The guidebook includes information on highly tinted single stars, double and multiple stars, variable stars, asterisms and stellar associations, open and globular clusters, diffuse and planetary nebulae, and galaxies including the Milky Way.

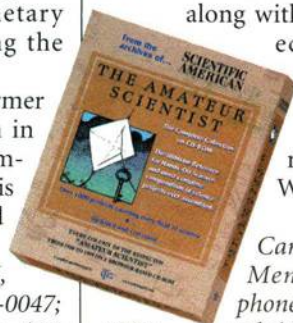
Some of what Mullaney, a former curator of the Buhl Planetarium in Pittsburgh, Pennsylvania, has compiled is available as software, but his hardware requires no batteries and offers room for notes.

James Mullaney, P.O. Box 1146, Exton, PA 19341; phone, (610) 269-0047; e-mail, jimullaneysm@msn.com. \$33 (if outside the United States, add \$5 for shipping).

The Amateur Scientist: The Complete 20th Century Collection

► A complete collection of *Scientific American's* "The Amateur Scientist" columns, which debuted in 1928, is available on CD-ROM. The column, which was initially titled "The Back Yard Astronomer," inspired Albert G. Ingalls's classic book *Amateur Telescope Making* and helped to promote the amateur-astronomy hobby.

The CD contains columns by Ingalls, C. L. Stong, Jearl Walker, Forrest Mims, and Shawn Carlson in a fully text-searchable format. Supplementary information and updates are included along with 1,000 how-to projects covering all the



major scientific fields. Carlson edited the CD, which runs on Macintosh, Windows, and Linux.

Tinker's Guild, 405 El Camino Real, PMB 326, Menlo Park, CA 94025; phone (and fax), (650) 853-1001; website, <http://www.tinkers-guild.com>. \$89.95 (plus shipping and sales tax if applicable).

LaserMate Collimator

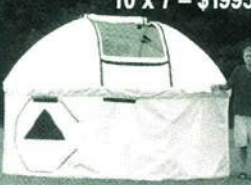
► Orion's new LaserMate Collimator has advantages over older collimators: It is compact and lightweight at 3.3 inches long and 5.5 ounces, and it is powerful enough so that it can be used during daylight hours.

Collimation, the process of aligning a telescope's optical elements with respect to one another, ensures that a telescope will provide the best possible views. The LaserMate's red laser beam allows for the pinpoint adjustment of the primary and secondary mirrors of a Newtonian telescope to a finer degree than that possible with a sight-tube collimator.

The black-anodized aluminum LaserMate is machined to a tolerance of plus or minus 0.002 inch, and power is supplied by three LR-44 watch batteries.

Orion Telescopes and Binoculars, 89 Hangar Way, Watsonville, CA 95076; phone, (800) 447-1001; website, <http://www.telescope.com>. \$64.95 plus shipping and handling.





10 x 7 - \$1995



10 x 8.5 - \$2295



**It will
change
the way
you look
at the
stars**

Sky
Tent

- Simple 1-person setup-25 min, no tools
- Dome rotates 360° on stationary base
- Weighs 100 lbs, packs easily in car
- Eliminates wind vibration & chill
- Several sizes, from \$1995

- Highly UV resistant
- Stable in 60mph+ wind
- Blocks local light pollution
- Withstands heavy rain & snow
- Portable or permanent installation

www.skytent.com TOLL FREE 1-877-SkyTent

FOR THE LOWEST
PRICES & BEST SERVICES
TO ORDER CALL TOLL FREE
1-888-4ASTRONOMY
(1-888-427-8766)
Phone Orders: Mon through Sat. 9-6
Pacific Standard
Times

WOODLAND HILLS Camera

Telescopes • Electronics

5348 Topanga Canyon Blvd., Woodland Hills, CA 91364

TEL: 818-347-2270 • FAX: 818-992-4486

**FOR THE LOWEST
PRICES & BEST SERVICES
TO ORDER CALL TOLL FREE
1-888-4ASTRONOMY
(1-888-427-8766)**

Phone Orders: Mon through Sat. 9-6
Pacific Standard
Times

FULL LINE MEADE STOCKING DEALER

TELEVue - DAY SALE JAN 20

Plossl-50°	
8-11, or 15.....	\$82
20 or 25mm.....	\$95
Panoptic-68°	
15mm.....	\$210
19mm.....	\$240
Nagler-82°	
4.8mm.....	\$175
7mm.....	\$220
Nagler type 4 12mm.....	\$370
Nagler type 5 31mm.....	\$595

SCOPE SAVER

LX200 Scope Saver 11.5"x 20"\$98

- A must for 10" LX owner
- Fits 7"-12" Meade scopes
- Hold 12 eyepieces! Holds keypad Securely

LOSMANDY



G11- Mount with dual access drive.
\$1,895.00

GM-8 mount, dual access drive.
\$1,399.00

JMI

Precision Fault-Free Focuser

NGFS.....\$269.00

Moto Focuser Non-vignetting adapter.....\$45.00

Wheely Bars

Universal 8" or 10" SCT.....\$159.95

12" LX200.....\$199.95

Custom-Made.....\$250.00

PENTAX

65° Field

5.2 or 7mm.....	\$229
10.5 or 14mm.....	\$219
21mm.....	\$229
28mm.....	\$219

MEADE



Meade

7", 8", 10" & 12"

Dobs, Newtonian, SCT's & Refractors in stock.

We have the complete line of Meade CCD cameras in stock.

Meade Maksutov 90

ON SPECIAL

with Electric Focuser

Trade in your old Maksutov for a new one.

Refractors 60,70 IN STOCK STARTING AT \$269**

Meade DS Telescope Sale

DS 60, 70, 80, 90, 114, 127 CALL

Complete line of DS Telescopes in stock.

Full line of accessories in stock.

CELESTRON®

C8 Deluxe	Call
CG11	Call
Ultima 2000	\$2479
G3 (With Motor)	\$329
65 (With Motor)	\$649
114 Deluxe (With Motor)	\$199

CELESTRON 1 1/4" EYEPIECES

ULTIMA EYEPIECES

5mm, 1 1/4".....	\$69.95	7.5.....	\$69.95	12.5mm, 1 1/4".....	\$69.95
18mm, 24mm, 1 1/4".....	\$79.95	30mm, 1 1/4".....	\$84.95	35mm, 1 1/4".....	\$99.95
42mm 1 1/4".....	\$99.95	Ultima Barlow Short Tube Version.....	\$69.00		

PLOSSL EYEPIECES

6.3, 7.5, 12.5, 10, 17, 1 1/4".....	\$39.95
32, 40mm, 1 1/4".....	\$59.00

Celestron C90 Rubber Armored 1 1/4" Eyepiece.....\$349

FREE EXTRA EYEPIECE!

The New NexStar 8

GoTo Telescopes by Celestron

In stock.....CALL

TELRAD FINDER\$39.95

Thousand Oaks Solar Filters (Mounted Glass)

8" Solar Filter	Call
10" Solar Filter	Call
12" Solar Filter	Call





LET OUR FACTORY TRAINED EXPERT HELP YOU WITH YOUR TELESCOPES NEED CALL US 818-347-2270

WE SHIP ANYWHERE • VISIT OUR WEB SITE WWW.TELESOPES.NET



See the splendors of
the sky while on safari!

Solar eclipse 2001 Zimbabwe, AFRICA

June 11 - June 22, 2001 Or
June 19 - June 30, 2001

Enjoy every second of the three-minute eclipse in a cloudless African sky. You'll have the opportunity to see exotic safari animals such as lions, elephants, cheetahs, cape buffaloes, hippopotamuses, impalas, and crocodiles! Join *Astronomy* editors for an amazing adventure of a lifetime!

Choose whichever tour best accommodates your personal schedule. Both magnificent excursions include:

- A fantastic view of the eclipse in a massive, clear sky.
- First-rate accommodations both in the city and on safari.
- A trip to the breathtaking Victoria Falls.
- Plus so much more!



Space is limited,
so call today!

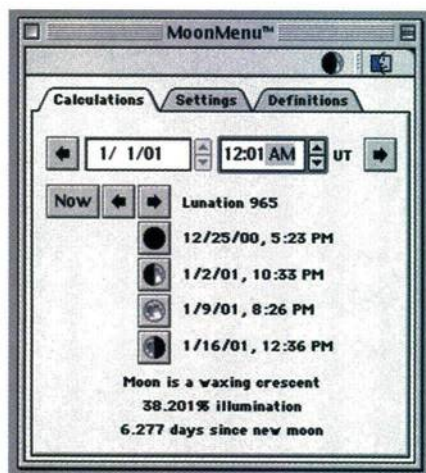
(800) 677-9412

www.a1specialtytours.com



MoonMenu

► Seated at your keyboard, the moon can always be in your view with this



nifty system-extension software, which draws the current phase of the moon onto the menu bar of your Macintosh. A simple click on the moon icon reveals the lunar phase, illumination percentage, the age in days of the current lunar cycle, the current lunation number, and upcoming quarter predictions.

MoonMenu is “a creative and intellectual vent” for Tucson, Arizona, computer scientist and software consultant Sanford Selznick. His software, which is available in English, French, German, and Japanese versions, includes a feature that computes lunar data for any date and time.

Selznick Scientific Software; website, <http://www.selznick.com/>. \$12 for one user, \$18 for two users, \$40 for five users, or \$70 for 10 users.

Sunspotter

► Most people might not immediately suspect that this triangular wooden device is a telescope because they may never have seen anything like the Sunspotter, a device from Learning Technologies that provides a convenient, and indirect way to view the sun.

A 62mm objective lens and a series of mirrors mounted inside the triangular structure project a bright, 3-inch image of the sun onto a 5-inch-wide viewing screen.

Several students in a science class or scout troop can simultaneously view the

sun’s disk and take turns tracing the movement of sunspots from hour to hour or day to day.

The Sunspotter also is a great tool to view solar eclipses. For maximal viewing, the wooden, folded-Keplerian telescope comes with a curved cradle that is easy to adjust as Earth rotates.

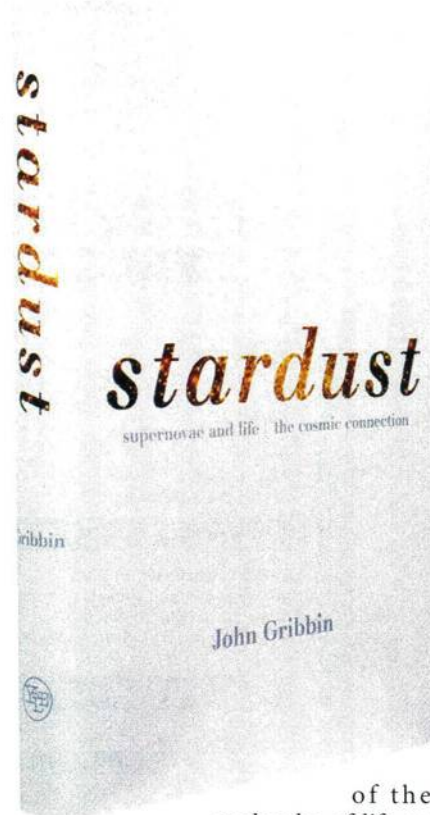
Learning Technologies, Inc., 40 Cameron Ave., Somerville, MA 02144; phone, (800) 537-8703 (U.S. only) or (617) 628-1459; fax, (617) 628-8606; e-mail, starlab@starlab.com; website, <http://www.starlab.com>. \$300 (plus shipping and handling).



Stardust: Supernovae and Life — The Cosmic Connection

John Gribbin with Mary Gribbin, 238 pages, Yale University Press, New Haven, Conn., 2000: ISBN 0-300-08419-6, hardcover, \$24.95.

► “This book explains the relationship between life and the universe, from the Big Bang to the arrival



of the molecules of life on the surface of Earth,” begins Gribbin on page one of *Stardust: Supernovae and Life — The Cosmic Connection*. Gribbin, author of several best-selling science books, including *In Search of the Big Bang*, and *The Birth of Time: How Astronomers Measured the Age of the Universe*, strikes literary gold again as he illustrates the human connection to the stars. Gribbin’s lucid and cogent presentation leaves no one behind.

In *Stardust*, Gribbin leads readers on a fact-filled tour of the origin of the elements. With a crash-course on the evolution of stars, and through the latest chemical synthesis and supernova research, he makes a convincing case that we literally owe our lives to the

If You Look Hard Enough, You Can See The Future.



Celestron® sends your gaze deeper into the star-studded past of our universe by keeping one eye steady on the future. Hand-figured optics, precisely ground, perfectly matched and thoroughly tested, capture and focus the slightest glimmer of light. Breakthrough engineering thoughtfully employs the latest

computer technology to enhance the human experience. Whether you select one of our advanced catadioptric telescopes, a refractor or a reflector scope, Celestron opens your eyes to the sky like no one else. If you want to use the technology of the future to see far into the past of space, look no further than Celestron.

FOR MORE INFORMATION ABOUT CELESTRON®: (310) 328-9560 • WWW.CELESTRON.COM





stars. Through it all, Gribbin's straightforward and unapologetic approach achieves simplicity without compromising factual integrity.

Rather than present dry scientific facts, Gribbin mixes his delivery. He switches between humor, international espionage, and analogy to explain "nucleosynthesis" — the process of fusing simple elements into heavier ones in the interiors of stars. At one point, he even uses vegetable soup to explain how subsequent generations of stars recycle chemical elements to ensure that the universe will remain "packed with the raw materials for life."

As Gribbin journeys into the past to remind all of us how far we've come, he reminisces about his own glory days with the Institute of Astronomy at Cambridge University in England. At that time, the Institute was directed by the eminent Fred Hoyle — a champion of steady-state cosmology and pioneer in the understanding of "Big-Bang Nucleosynthesis."

In addition, Gribbin highlights the great achievements of two scientists of the 1930s: George Gamow and Hans Bethe. It was Gamow, a theoretical physicist, who used his knowledge of quantum physics to predict that two positive charges could, with sufficient energy, overcome their mutual repulsion. After hearing about the prediction, Bethe reportedly set out to solve the problem of how stars generate light before he ate his next meal. The energized Bethe used Gamow's prediction to figure out the exact chain of nuclear reactions that produce starlight. Bethe finally did figure out how stars shine — and won the 1967 Nobel Prize in physics for his feat.

While Gribbin employs historical perspective to highlight the scientific method in action, he warns readers "that the history of science isn't always as neat and tidy as some of the accounts you read in books might suggest." Gribbin's honest approach sets readers at ease.

And Gribbin's analysis is so complete that he's included an appendix with the latest speculation on possible evolution and natural selection among parallel universes. He suggests "that there may at least be an analogy (and perhaps much more) between the origin and evolution of the entire universe and the origin and

evolution of a living organism." In a time when scientists routinely detect water and complex organic molecules such as sugars in interstellar space and find signs of life in the most inhospitable places on Earth, Gribbin's *Stardust* blends fact and speculation to make the case that life likely abounds in the universe. If we actually do understand all that we think we do, the conclusion is truly astounding.

"We have answered the biggest question of all — Where do we come from?" offers Gribbin. — *William Schomaker, associate editor*

Science and Technology Encyclopedia

572 pages; The University of Chicago Press, Chicago, 2000; ISBN 0-226-74267-9; paperback, \$22.50.

► This compact encyclopedia is the ideal reference manual to keep at your side while reading scientific articles on any topic. Its 6,500 entries give precise, clearly written explanations of science and technology subjects, including astronomy, math, physics, chemistry, biology, and information technology. More than 20,000 cross-references, listed in small capitals, lead readers to related topics and information. More than 250 black-and-white illustrations supply further detail to

schematic and technical cutaway diagrams as well as representational natural history artwork. *Science and Technology Encyclopedia* also includes biographies of more than 850 historical and contemporary scientists. Chances are you'll pick up this book and just start browsing.

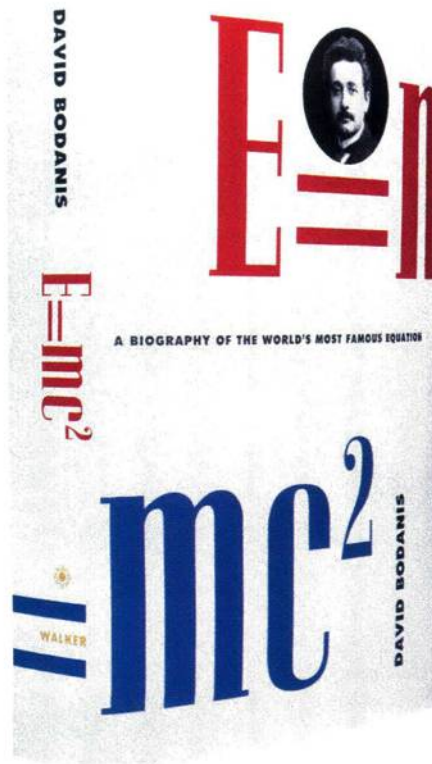
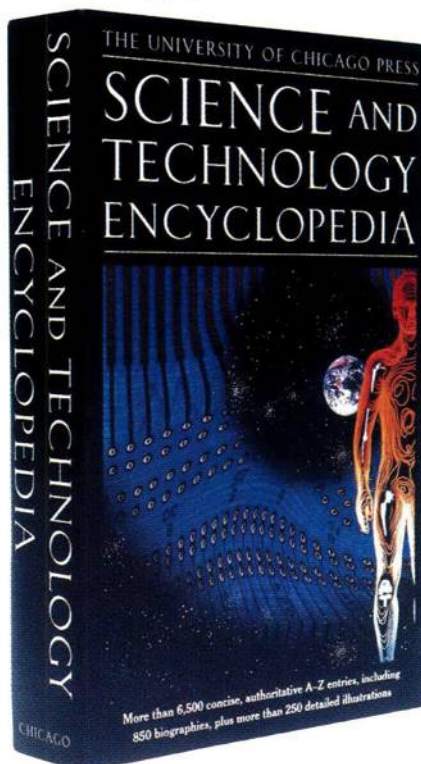
$E=mc^2$: A Biography of the World's Most Famous Equation

David Bodanis, 323 pages, Walker & Company, New York, 2000; ISBN 0-8027-1352-1; hardcover, \$24.

► David Bodanis's anthropomorphic look at $E=mc^2$ brings to life a mathematical formula that enjoys a ubiquitous presence in our daily lives. From medical devices that detect tumors to household smoke alarms to the origin of stars to the death of the solar system, the $E=mc^2$ equation provides the short answer to our existence. But while nearly everyone has heard of or seen $E=mc^2$, few understand it.

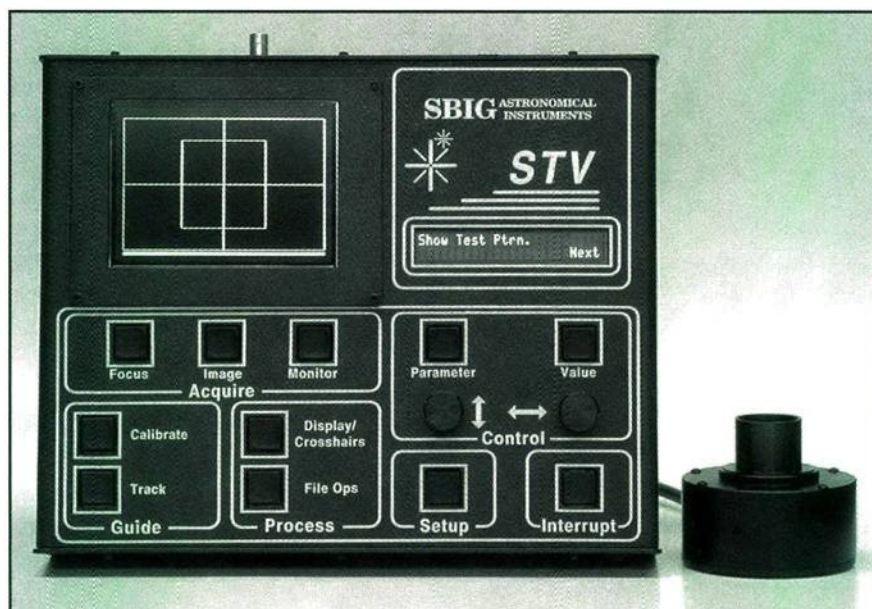
Until now.

$E=mc^2$ explains the background, evolution, and development of what is perhaps the governing formula as to why we are here. The stories behind it blend unexpected





ANNOUNCES THE REVOLUTIONARY **STV**



The First **STAND ALONE DIGITAL INTEGRATING VIDEO CAMERA AND AUTOGUIDER**

LIKE NO OTHER ASTRO CAMERA OR AUTOGUIDER IN THE WORLD

- ♦ EASY TO USE, PORTABLE - **NO COMPUTER REQUIRED**
- ♦ VIEW THE MOON, PLANETS **AND** DEEP SPACE OBJECTS ON ANY VIDEO MONITOR OR ON THE OPTIONAL BUILT-IN 5" LCD DISPLAY
- ♦ RECORD VIDEO IMAGES ON ANY VCR ♦ NO FRAME GRABBER REQUIRED
- ♦ STORE DIGITAL IMAGES IN THE STV's INTERNAL MEMORY FOR DIRECT DOWNLOAD TO A COMPUTER AT A LATER TIME
- ♦ OPERATES AS A STAND ALONE AUTOGUIDER, 30 TIMES AS SENSITIVE AS A ST-4
- ♦ REACH 14th MAGNITUDE IN ONE SECOND (18th MAGNITUDE IN ONE MINUTE) THROUGH AN 8" SCOPE



SANTA BARBARA INSTRUMENT GROUP

147-A Castilian Drive
Santa Barbara, CA 93117
Phone (805) 571-7244 FAX (805) 571-1147
e-mail: sbig@sbig.com Home address: www.sbig.com



emotions such as passion, love, and revenge with scientific research and discovery. Divided into three parts, *E=mc²* follows the normal biographic pattern of linear progression of a life — in this case, the “life” of an equation. Bodanis describes how Einstein used the ancestral components, E , m , c , $=$, and ^{2} to meld the ideas that were floating through his mind to make sense of his (and our) world.

The book delves into the importance of Einstein's equation in determining the outcome of World War II and — ultimately — the history of the 20th century. Bodanis tries to neatly wrap up his argument with how $E=mc^2$ has become an integral part of our lives today and forever.

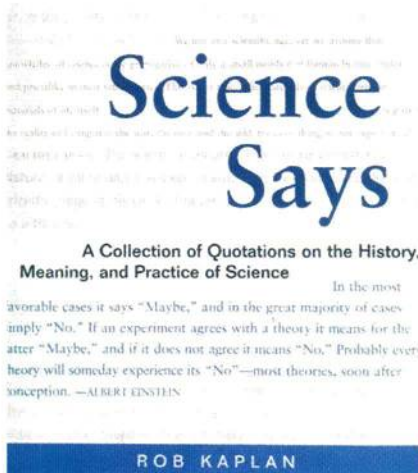
Readers will find additional details, history, and mathematical depth by visiting Bodanis's website: <http://www.davidbodanis.com>.

The Neptune File: A Story of Astronomical Rivalry and the Pioneers of Planet Hunting

Tom Standage, 256 pages, Walker & Company, New York, 2000; ISBN 0-8027-1363-7; hardcover, \$25.

► *The Neptune File* tells the tale of the first time scientists used calculations — rather than strict observation — to discover a planet. While it's a fine example of cutting-edge 19th-century science, it's also a discovery fraught

with secrecy, arrogance, and inaction that emphasizes the never-changing psychological flaws inherent in humans. Standage tells the story of how the egos involved in the prediction and discovery of Neptune fostered the dramatic international rivalry that ensued. Perhaps the most amazing part of *The Neptune File* is the epilogue modern scientists are continuing to write as they incorporate some of the methods used in this discovery into the discipline of present-day extrasolar-planet hunting.



Science Says: A Collection of Quotations on the History, Meaning, and Practice of Science

Rob Kaplan, 254 pages, Stonesong Press, W. H. Freeman and Company, New York, 2001; ISBN 0-7167-4112-1; hardcover, \$19.95.

► In the 1980 book *The Restaurant at the End of the Universe*, Douglas Adams writes, “There is a theory which states that if ever anyone discovers exactly what the universe is for and why it is here, it will instantly disappear and be replaced by something even more bizarre and inexplicable. There is another which states that this has already happened.”

Science Says author Kaplan comes at science from a direction that is equally unique. You'll find thought-provoking, humorous, ironic tidbits to ponder or mention to friends. The quotations he has chosen range from the expected (“I have no special talents. I am only passionately curious.” — Albert Einstein), to the famous (“I am sorry to say that there is too much point to the wise-

crack that life is extinct on other planets because their scientists were more advanced than ours.” — John F. Kennedy), to the irreverent (“... astronauts go to the moon, and what do they do? They collect rocks... lope around... play golf... and plant a flag. With one giant step mankind took banality out of America and into the cosmos.” — Lily Tomlin).

Science Says is fun, not only because of what it holds, but also because it's fun to hold. It's a great stocking stuffer that fits easily into a briefcase or large purse. Take it with you on your next dental appointment or on vacations. Most of the quotes in the 14 chapters will make you smile: A difficult task would be choosing our favorite. **A**

The Webweaver Picks

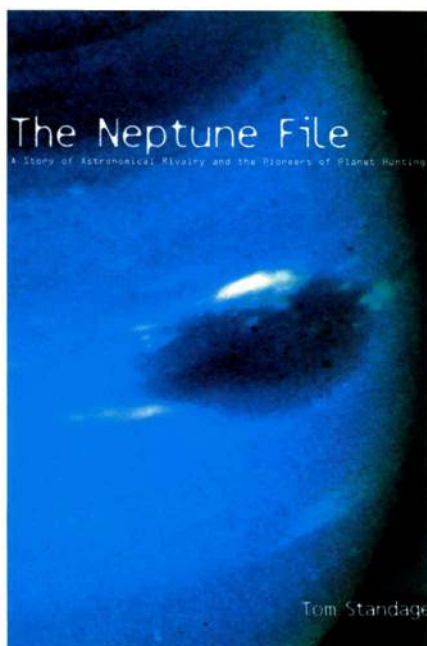


Save the Pluto-Kuiper Express Mission
A Pennsylvania teenager recently created this website to save the mission to Pluto from the budgetary ax:
<http://www.plutomission.com/>

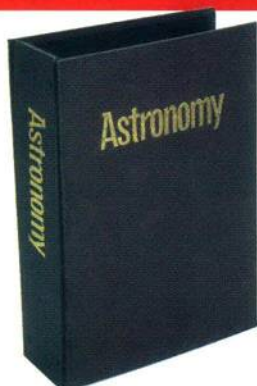
Geek-O-Meter
Are you female and know what CELP stands for? If so, gauge your geekiness quotient here:
<http://register.girlgeeks.com/gom3enter.html>

Museum Tour
If you are looking for science toys for kids on your holiday gift list, 21 U.S. science centers, zoos, aquariums, and manufacturers have made it easy for you:
<http://www.museumtour.com>.

Space Day 2001
Students in grades 4 to 6 and their teachers and parents can get ready for Space Day on May 3, 2000, at this cool site:
<http://www.spaceday.com>.



PROTECT YOUR INVESTMENT!



Preserve your library
of **ASTRONOMY**
Magazines with
durable hardcover
binders.

ITEM NO. 14007
1 for \$12.95 • 3 for \$35.95
5 for \$54.95

Order yours today!

TO ORDER BY MAIL: Send your order to Kalmbach Publishing Co., Dept. A1840, 21027 Crossroads Circle, P.O. Box 986, Waukesha, WI 53187-0986. Use chart below for shipping & handling charges.

MERCHANDISE TOTAL	ADD
\$10.00 or less	\$3.95
\$10.01-\$30.00	\$4.95
\$30.01-\$50.00	\$5.95
\$50.01-\$75.00	\$6.95
\$75.01 or more	\$7.95

Canada add an additional \$2.00, other foreign add an additional \$5.00. For Wisconsin delivery, add 5% sales tax to total; for Pennsylvania delivery, add 6% sales tax to total. For delivery in Canada add 7% GST to total. Payable in U.S. funds. Checks must be drawn on a U.S. bank except for those from Canada; GST included. Make checks payable to Kalmbach Publishing Co. Prices and availability subject to change.

call 800-533-6644

Mon-Fri, 8:30am-5:00pm Central Time.
Outside the U.S. and Canada, call 262-796-8776.
Please have your credit card ready.

fax 262-796-1615

www kalmbachbooks.com

Secure online ordering available.

Astronomy®

5664-0012

A1840

A new doorway is opening to the Universe!



Photo: REU program, N.A.Sharp/AURA/NOAO/NSF

Astro-tourism defined for the
new age of exploration

 **Astronomy.com**



DURANGO
MOUNTAIN RESORT
COLORADO




KIRKWOOD
Kirkwood Mountain Resort
www.skirkwood.com

Astronomy
Magazine

www.StarSafaris.com

ADORAMA

42 WEST 18th STREET • NEW YORK, NY 10011

PHONE ORDERS ACCEPTED

DAY OR NIGHT

• Mon-Thurs. 9 till 9:30 PM

• Fri. 9-1:45

• Sunday 9:30-6 EST

STORE HOURS:

• Mon-Thurs. 9-6:30pm

INC. • Fri to 1:30 • SUN 9:30-5:30

web:

www.adorama.com

ORDER TOLL FREE • US & CANADA

800-7-ADARAMA
8 0 0 - 7 2 3 - 6 7 2 6

ORDERS & INFO

FAX

212-647-9800 **212-675-8715**

CUSTOMER RELATIONS • 800-815-0702

• Mon-Thurs 9-4:30, EST
E-mail: info@adorama.com

CELESTRON® SCHMIDT CASSEGRAIN

New Celestron Nexstar

Celestar 8 1099.00
Hand Control f/Celestar...54.95
Celestar 8 Deluxe.....1699.95
G-8 German Eq. 8".....999.95

Nexstar 5.....1199.95
Nexstar 8 W/Tripod.....1699.95

Celestron Reducer/ Corrector f/6.3

Works with all Current Celestron and Meade Schmidt Cassegrains. Now it is possible to have a dual focal ratio instrument without sacrificing image quality. The Reducer/Corrector is f/6.3 for C8 and C11, f/7 for C14. A four element, fully multi-coated accessory. Results are amazing BOTH visually and photographically.



104⁹⁵

ACCESSORIES for NEXSTAR 5"

JMI

Motofocus 101.95
Megapod Tripod w/Wedge 199.95
Carry Case 129.95

Celestron Tripod.....174.95
Celestron Case.....149.95

CELESTRON TELESCOPE ACCS.

AC Adpt. C5+, C8+ Ultima 18.95
Car Bat. Adpt. C5+, C8+ Ultima 19.95
2X Barlow 1.25" Short Tube 39.95
Counterweight Bar Assembly
8" 84.95
Case for C8/C5 179.95
Piggyback Mt 8" 34.95
Piggyback Bar Assembly 11" 69.95
New Folding Lens Shades Call

MOTORS

JMI DEC Motor C8+/Classic 8. 84.95
JMI Motofocus f/Celestar 8,
Nexstar 8 101.95
Celestron Focus Motor 109.95
Logic Drive f/CG3 29.95
S/A Drive w/Hand Cntrl f/CG-3 79.95
Single Axis Motor for CG-5 114.95
Dual Axis Drive for CG-4 159.95
Dual Axis Drive for CG-5 169.95

ADVANCED ASTRO MASTER

Advanced Astro Master for C8 11,
& G5 Mount 474.95

FILTERS

LPR A 59.95 LPR B 84.95
Pol. Set 1 1/4" 44.95 Sky Filter #2 44.95
4 piece 1.25" FilterSet 49.95

DIAGONALS

Diagonal Erect 1.25" 45° 39.95
Diagonal Erect 1.25" 90° 49.95
Star Diagonal 1.25" 90° 34.95
2" Mirror Star Diagonal 124.95

ULTIMA EYEPIECES

5mm, 1 1/4" 67.95 7.5, 1 1/4" 67.95 12.5mm, 1 1/4" 67.95
18mm 1 1/4" 67.95 30mm, 1 1/4" 84.95 42mm, 1 1/4" 89.95
35mm 1 1/4" 96.95 2X Ultima Barlow Lens 62.95

POSSL EYEPIECES

7.5, 17mm, 1 1/4" 31.95
NEW NEXSTAR POSSL EYEPIECES 1.25"
3.6, 6, 8, 10, 13, 17, 25mm 39.95 32, 40mm 49.95

NEW AXIOM EYEPIECES

15mm 1 1/4" 129.95 19mm 1 1/4" 139.95 23mm, 1 1/4" 149.95
19mm 2" 169.95 34mm 2" 209.95 40mm, 2" 249.95
50mm 2" 274.95

Vixen Lanthanum Eyepieces LV Series

2.5mm 94.95 4mm 94.95 5mm 94.95
6mm 94.95 9mm 94.95 10mm 94.95
12mm 109.95 15mm 94.95 8-24mm Zoom.....159.95

Pentax XL SMC Eyepieces

5.2, 7, 10.5, 14, 21, 28mm, 1.25" 219.95 40mm, 2" 239.95

CELESTRON NEW NEXSTAR REFRACTORS

Nexstar 60-ST 189.95
Nexstar 60-GT 299.95
Nexstar 80-HC 299.95
Nexstar 80-GT 399.95
New Nexstar 60/80
Soft Case 79.00
New Nexstar 80/114 Hard
Case (for Scope only) 99.00

NEW NEXSTAR REFLECTORS

Nexstar 114 HC 399.95
Nexstar 114 GT 499.95

REFLECTORS

8" Reflector 699.95
C-150 Heavy Duty
6" Reflector 499.95
C-114 HD 299.95
Firstscope 114 Deluxe 189.95
Firstscope 114 Premium 209.95

STAR HOPPER Dobsonian

4.5" 219.95
6" 299.95
8" 389.95
6x30 LER
Finder scope 39.95

SPOTTING SCOPES

C90 MC w/1.25" Eyepiece Call
Ultima 65 129.95
Ultima 80 209.95
15-60X Zoom 144.95
80mm Wide Field with 2 Plossl
Eyepieces Call
New 102mm Wide Call

COMPACT G3 3.5" & G5 5" SCHMIDT CASSEGRAINS with Equatorial Mounts

G-3 3.5" w/Motor Drive 319⁹⁵

G-5 5" \$699⁹⁵

Free 10mm Eyepiece
w/ purchase of G3/G5 Telescopes



Tele Vue®

WE STOCK THE COMPLETE LINE
of Tele Vue Plossls, panoptics, Naglers,
Radians, Barlows & Powermates

TELE VUE REFRACTORS



PRONTO

70mm Aperture
f/6.4 with ED Glass
925.00

101mm and 85mm
REFRACTORS

101mm 2760.00
85mm 1995.00

SKYGAZER SERIES TELESCOPES

80mm Equatorial

910mm focal length (f/11.4)
German Equatorial
Mount, slow motion
controls, setting circles,
25mm 1.25" eyepiece (36X),
1.25" diagonal, 6x30 finderscope,
adjustable
wood tripod only 224.95

SPECIAL OFFER
80mm Refractor
includes a **FREE**
Single Axis Drive

SKYGAZER 60 EQUATORIAL

900mm f/15 Refractor, Two 1.25"
Eyepieces, German Equatorial
Mount, Slow Motion Cables, Setting
Circles in both axes, 6x24, Finderscope,
Hybrid 1.25" Diagonal, Adjustable
Tripod only 139.95

SKYGAZER 114 (4.5)

114mm diameter Reflector with German
Equatorial Mount, Slow Motion Controls
in R.A. and DEC., 5x24 Viewfinder, Two
1.25" 25mm (36X) & 10mm (91X)
Eyepieces, Adjustable Wood Tripod
with Accessory Tray

SPECIAL OFFER
includes a **FREE**
Single Axis Drive

Equatorial Deluxe Reflector Telescope

\$189.95

**STEREO BINOCULAR
VIEWER \$479.95**

BUSHNELL

60mm Zoom Voyager Refractor 79.95
60mm Zoom Voyager Refractor with Rotary Eyepiece 89.95

Bushnell Compact 4.5" Reflector

\$154.95

Features a unique cradle mount which is
convenient to use and transport. A wide field of
view makes it easy to locate objects and
keep them in view
• Aperture: 4.5" • Focal Length: 400mm
• Eyepieces: 1.25" 4mm (100X), and 25mm (16X)
• Focuser: Precision Rack & Pinion,
Tripod adaptable, includes convenient shoulder strap



TELESCOPE ACCESSORIES

DEW SHIELD

Collapsible, fold down, easy to store and transport
for Celestron C90 18.95 f/10" Schmidt Cassegrains.....38.95
f/8" Schmidt Cassegrains.....28.95 f/11" Scopes.....49.95
f/5" Scopes.....24.95

LUMICON FILTERS

BUY ANY 2 FILTERS AND TAKE **7% OFF** THESE PRICES
UHC Premium, Deep Sky Premium, H-Beta or Oxygen III
1 1/4" 99.50 48mm 199.95 2" T Mount 199.95

TELRAD FINDER

TELRAD with Base.....36.95 Spare Mounting Base.....7.95
Dew Shield for Telrad.....11.95

EASY TESTER

Optical Evaluation Eyepiece 29.95

JMI FOCUSERS

NGF-DX1 233.00 NGF-S w/Motofocus 242.00
NGF-DX2 180.00 NGF-DX3 144.00

SOLAR FILTERS GLASS

for Celestron C90/G3 & Meade ETX 59.95
for Televue Genesis/101 59.95
for Pronto/Ranger Televue 49.95
for Celestron 5" 69.95
for Schmidt Cassegrains 8" 89.95
for Meade 10" 109.95



WE SHIP PROMPTLY. ALL TELESCOPES INCLUDE U.S.A. WARRANTY
No Surcharge for MasterCard or Visa Purchases. Personal checks welcome, will ship without delay. Name must be imprinted on check, also include address, phone, and a
copy of major credit card or driver's license for reference. Shipping, handling and insurance additional. 14 day money back guarantee less shipping, with packing and blank war-
ranty card, credit film and paper. We ship UPS. Some items special order. All orders are subject to acceptance and verification. Second hand dealer's license #802862.
Pictures are for illustration purposes only and may not be exact. We are not authorized Meade dealers.
Prices effective till Jan. 10, 01 Please address all inquiries and orders to ASTRO. DEPT. #55

Your Credit Card Will Only Be Charged At Time Of Shipping For Items Actually Shipped



2001

ADORAMA

42 WEST 18th STREET • NEW YORK, NY 10011

PHONE ORDERS ACCEPTED

DAY OR NIGHT

• Mon-Thurs. 9 till 9:30 PM

• Fri. 9-1:45

• Sunday 9:30-6 EST

STORE HOURS:

• Mon-Thurs. 9-6:30pm

• Fri to 1:30 • SUN 9:30-5:30

web:

www.adorama.com

ORDER TOLL FREE • US & CANADA

800-7-ADORAMA
 8 0 0 - 7 2 3 - 6 7 2 6

ORDERS & INFO

FAX

212-647-9800 **212-675-8715**

CUSTOMER RELATIONS • 800-815-0702

• Mon-Thurs. 9-4:30, EST

E-mail: info@adorama.com

BINOCULARS

Adorama Provis Series Binoculars

Deluxe, Lightweight with enhanced Multi-Coating. Full-sized binoculars in a compact and lightweight high-quality cast-aluminum alloy housing with a soft leatherette covering.

- BAK-4 glass porro prisms.
- Full Multi-Coating. Every air-to-glass surface is multi-coated to increase light transmission, better image contrast and color balance.
- Soft grey leatherette covering.
- Threaded to accept tripod adapter.
- Long Eye Relief, ideal for eyeglass wearers.
- Roll down rubber eyecups.
- Supplied with Deluxe Hard Carrying Case
- Rated "Exceptional Inspection Standard" by the Japanese J.T.I.I.



PROVIS Binocular	Eye Relief	Field of View	Near Focus	Size HxW	Weight oz.	Price
8x42	16mm	6.5°	16'	4.92" x 6.85"	22.2	129.95
7x50	23mm	6°	26'	6.42" x 7.24"	27.8	109.95
10x50	16mm	5.3°	26'	6.22" x 7.24"	27.8	124.95

NIGHT VISION

BINOCULARS

Compact Binocular 30,000X 4X Mag. 399.95
 30,000X Goggles 1X Mag. Focuses as close as 9'...599.95

MONOCULARS

NOOC Explorer water Resistant 3.1X Mag. 15,000X...199.95
 NOOC Explorer water Resistant 5X Mag. 15,000X...274.95
 NOOC Odyssey water Proof 3.1X Mag. 15,000X...249.95
 Lens Doubler...34.95 Camera Adapter 34.95

TASCO

NV-360 Monocular 279.95
 Camera Adapter for 360 49.95

Night Owl Cyclops With Camera Adapter

- 15,000 Light Magnification
- 3.1x Image Magnification
- Premium performance and styling
- The highest quality optics designed and coated specifically for night time use
- Powerful integrated infrared illuminator

**164.95**

ASTRONOMY BOOKS

Books for Beginners

Nightwatch: Equinox Guide...24.95
 Astronomy: Self-Teach Guide 18.95

Astrophotography & Imaging

CCD Camera Cook Book...29.95

Observers' Handbooks

The Backyard Astronomer's Guide...29.95
 Burnham's Celestial Handbook 3 Volume Set...39.95

Binocular Observing

Touring the Universe Through Binoculars...32.95

Building Telescopes

Telescope Building w/Dobson Video Tape...39.95

Night Navigator \$79.95

The Electronic Star Locator

Locates and Identifies Constellations Quickly.

- Scientific patented computer tracking system to accurately locate and identify constellations, planets, and stars quickly and effortlessly.
- Innovative built-in digital electronic compass automatically plots your location.
- Motorized map delivery system for easy sky navigation.



ASTRONOMY SOFTWARE

THE SKY for Windows 95

Version 5.0

Sky Level 2 or 3.....Call

Sky GSC (CD ROM) Level 4.....Call



No Surcharge for MasterCard or Visa Purchases. Personal checks welcome, will ship without delay. Name must be printed on check, also include address, phone, and a copy of major credit card or driver's license for reference. Shipping, handling and insurance additional. 14 day money back guarantee less shipping, with packing and blank warranty card, except film and paper. We ship UPS. Some items special order. All orders are subject to acceptance and verification. Second hand dealer's license #802862. Pictures are for illustration purposes only and may not be exact. We are not authorized Meade dealers. Prices effective till Jan. 10, 01 Please address all inquiries and orders to ASTRO. DEPT. #55

PROOPTIC BINOCULARS

Now includes
25 YEAR WARRANTY

These binoculars with their large objectives high quality BAK-4 prisms will provide you with breathtaking wide-field observation of astronomical objects as well as terrestrial viewing under low light conditions.

Each binocular is provided with a high quality Hard Case, Neck Straps and Rubber Eye-Cups.

70mm Jumbo Fully Multi-Coated Series

11x70 Jumbo - 4° field of view, 21mm eye relief, weighs 2.8 lbs. 159.95
 16x70 Jumbo - 3.6° field of view, weighs 2.8 lbs. 169.95



80mm Giant Fully Multi-Coated Series

11x80 Giant - 4.2° field of view, 14mm eye relief, weighs 5.25 lbs. 249.95
 20x80 Giant - 3.3° field of view, 14mm eye relief, weighs 5.25 lbs. 259.95



100mm Ultra Giant Series

The ultra large aperture of 100mm provides more than 50% more light gathering power than the standard 80mm Giant Binoculars.

For a delightful experience in astronomical viewing. Both feature multi-coated optics, BAK-4 prism, built-in platform which mounts on a tripod.

14x100 Ultra Giant...849.95 25x100 Ultra Giant...899.95

Provides Stunning Views of The Night Sky At A Price Far Below What Giant Binoculars Typically Cost ...BUDGET - PRICED...

As Written Up In Sky & Telescope June 2000



FUJINON FMT-SX Binoculars

14x40 Techno Stabl.....Call
 7x50 FMT-SX.....Call
 7x50 FMT-RSX.....Call
 7x50 FMT-RSX.....Call
 R.C. with Compass.....Call
 8x30 FMT-RSX R.C.....Call
 10x70 FMT-SX w/Case.....Call
 16x70 FMT-SX w/Case.....Call
 8x42 BFL.....Call
 10x42 BFL.....Call

CD Waterproof

7x42.....Call 8x42.....Call
 10x42.....Call

CANON

Image Stabilized
 10x30.....Call 12x36.....Call
 15x50.....Call
 18x50.....Call

PENTAX PCF

7x50.....Call 8x40.....Call
 10x50.....Call 12x50.....Call
 16x50.....Call 20x60.....Call

LEICA

w/USA Passport Warranty
 Call about New close focus Binoculars
 10x50 BA.....Call 8x50 BA.....Call
 12x50 BA.....Call
 7x42 GEOVID BD.....Call
 7x42 GEOVID BD.....Call

KOWA 82mm

w/20 to 60x Zoom
 TSN-821.....639 TSN-822.....609
 TSN-823.....1059 TSN-824.....1014

W/O Eye Piece

TSN-821.....399.95 TSN-822.....364.95
 TSN-823.....814.95 TSN-824.....769.95
 27x L.E.R.....134
 32x w/a.....194
 20-60x Zoom Eyepiece.....264.95
 P&G 82mm Photo Adap.....174.95
 20-60x f/60mm.....139.95

10x70



Fieldscope Super 80

Super 80 with 20X-60X.....Call
 Super 80 ED with 20X-60X.....Call

CELESTRON GIANT MULTI-COATED

20x80 Delux.....Call
 REGAL
 8x42.....Call 10x50.....Call
 NEW NOBAL
 8x32.....Call 8x42.....Call
 10x42.....Call 10x50.....Call

ULTIMA SERIES

7x50.....Call 8x40.....Call
 10x50.....Call 8x56.....Call
 9x63.....Call

MINI M/C with Case

8x21.....36.95
 10x25.....46.95 7-16x25.....64.95
 MONOCULAR-8x25.....34.95

BUSHNELL

Discoverer 15x60 Zn.....179.95
 Camera Adapter.....14.95
 Case f/Discoverer.....19.95
 Nature View 15-45X.....124.95
 Car Window Mount.....34.95

SPACEMASTER 60mm

78-1900 Basic.....149.95
 78-1917 Basic Kit.....247.95
 78-1200 Rubberized Arm.....163.95
 78-1217 Rubberized Kit.....259.95
 78-2317 RC Zoom.....229.95
 78-2318 RC L.E.R. Zoom.....224.95
 78-1821 RC L.E.R. ZM Kit.....264.95
 15-45X Zoom Eyepiece.....89.95
 20-45X L.E.R. Zoom.....89.95

ELITE Waterproof

15-45 60mm w/Case.....Call
 20-60x 70mm w/Case.....Call
 20-60x 80mm w/Case.....Call

PROOPTIC Astronomical Accessories

A unique combination of high quality and economical prices

Pro-Optic Plössl 1.25" Eyepieces

- Sharp detail • High contrast ghost-free images • Wide 50° apparent field of view (43° on the 40mm Plössl)
- 4 element optics
- Lens edges are blackened to keep out reflected light
- Accepts 1.25" filters.

NEW Reduced Prices!



MULTI-COATED PLOSSL EYEPIECES

40mm.....39.95 32mm.....39.95
 25mm.....29.95 20mm.....29.95
 17mm.....29.95 12.5mm.....29.95
 10mm.....29.95 7.5mm.....29.95
 6.3mm.....29.95

Short Tube Barlow

Double the power of any eyepiece with this Barlow. Only 2" long. Works with all type of telescopes, including Refractors and Reflectors

only \$31.95



Pro Optic 500mm f/5.6 Maksutov Telephoto/Spotting Scope

with High-Tech White Finish

Carry Case



Multi-coated to maximize contrast and sharpness and a built-in field flattener to reduce field curvature.

With its 500mm focal length, it is long enough for close-ups of far away objects but with the f/5.6 optics it is fast enough to be hand held, focuses as close as 5 feet.

With the addition of the S5500 Kit you can convert it to a 20X 90mm spotting scope. The S5500 kit includes a 45° 1.25" Erect Image Diagonal and a 25mm 1.25" Plössl

Pro-Optic 500mm f/5.6 lens.....209.95

Pro-Optic S5500 Kit (when purchased w/500/5.6).....49.95

350mm f/4 Converter for 500/5.6.....74.95

15-45x Fully Coated, 2.25" f.o.v. at

Fieldstar 15x, Long Eye Relief (33mm @

Spotting 15x) weighs only 25 oz.

Scope • Rubber Coated

Outfit includes Case & Table Top Tripod

New 15-45x Angle Spotting Scope Kit

w/Case & Table Top Tripod 119.95

Pro-Optic Slow Motion Control

29.95

Make accurate slow motion adjustments in altitude and Azimuth. In addition the Pro-Optic SMC allows you to make major adjustments in elevation with a separate control knob. The Slow Motion Control fits any tripod with 1/4-20 thread.

Pro-Optic 45° Erect Image Diagonal

Provides an ideal 45° angle for erect image terrestrial viewing

45° Erect 1.25".....34.95

45° Erect Hybrid (1.25" to .96").....34.95

90° Star Diagonal 1.25".....34.95

New Straight Through Erector (Porro Prism).....64.95

EYEPIECE FILTERS 1.25"

Available in the following colors: 1A Skylight; 8

Yellow; 11 Yellow Green; 12 Deep Yellow; 15 Deep

Yellow; 21 Orange; 23A Red; 25 Red; 47 Violet; 56

Light Green; 58 Green; 80A Lt. Blue; 82A Pale Blue;

ND 0.3; ND 0.6

1.25" @.....9.95 Moon Filter 1.25" (ND 9X).....11.95

Buy any 4 filters (1.25")...for only 34.95

Buy any 12 filters.....for only 99.95

4 Piece Filter Set with Pouch

Set #1 includes: #12, 23A, 58 & 80A

Packaged in a Pouch.....34.95

Set #2 includes: #11, 25A, 47

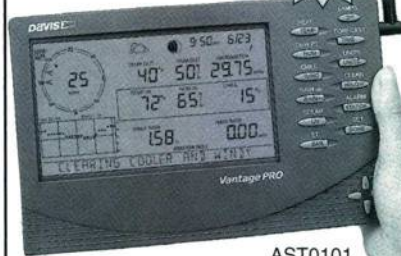
& 82A.....34.95



VISIT US ON THE WEB AT WWW.ADORAMA.COM

THE BEST HOME WEATHER STATION EVER MADE.

BRAND NEW!
\$595.00



AST0101

Davis unleashes its Vantage Pro wireless weather station! Revolutionary thinking, with professional quality, accuracy, and performance.

Forecasts 30 different weather conditions, shows over 80 graphs, and sounds over 70 weather alarms. All in a display that's easy to read and use.



It's the best value you'll find anywhere!

CALL TODAY FOR YOUR FREE CATALOG!
1-800-678-3669 • www.davisnet.com

Davis Instruments 3465 Diablo Ave.
Hayward, CA 94545

Astronomy Magazine Calendar 2001

Includes striking images of dramatic celestial observations such as an X-ray image of a supernova, a partial solar eclipse, the Orion Nebula, Mars, astronauts in space, and much more. Recognizes national holidays, data on viewing numerous celestial events, and seasonal star charts. 12x12.

68116 • \$12.95

Ask for this product at your favorite bookstore! Or order direct:



NEW

To order by mail: Send your order to Kalmbach Publishing Co., Dept. AFIL, 21027 Crossroads Circle, P.O. Box 986, Waukesha, WI 53187-0986. Use the chart below for shipping & handling charges.

Merchandise total	Add for shipping
\$10.00 or less	\$3.95
\$10.01-\$30.00	\$4.95
\$30.01-\$50.00	\$5.95
\$50.01-\$75.00	\$6.95
\$75.01 or more	\$7.95

Online www.astrology.com

Secure online ordering available.

Call 1-800-533-6644

Mon-Fri, 8:30am-5:00pm Central Time. Outside the U.S. and Canada, call 262-796-8776. Please have your credit card ready.

Fax orders to 262-796-1615.

Canada add an additional \$2.00, other foreign add an additional \$5.00. For Wisconsin delivery, add 5% sales tax to total; for Pennsylvania delivery, add 6% sales tax to total. For delivery in Canada add 7% GST to total. Payable in U.S. funds. Prices and availability subject to change.
\$291-2001 AFIL

DISCOVERY TELESCOPES

No other telescope manufacturer combines large aperture with the quality and value of Discovery's Truss Design and Premium DHQ telescopes.

- Compare optics
- Compare components
- Compare price

You'll Buy Discovery

Order before 12/28 to secure current pricing.

TRUSS DESIGNS

- ApplePly construction
- Your choice of Telrad® or 7x50 finderscope
- EbonyStar®/Teflon® bearing surfaces
- 2" Crayford focuser
- Premium Pyrex® mirror set with enhanced aluminum coatings



12.5" f/5
62.5" (1587mm)
\$1999

15" f/5
75" (1905mm)
\$2499

17.5" f/5
87.5" (2222mm)
\$2999

PREMIUM DHQ

- Lightweight, strong Baltic Birch base
- Your choice of Telrad® or 7x50mm finderscope
- Exclusive, huge oversize, adjustable tube bearings
- EbonyStar & Teflon bearing surfaces
- Premium Pyrex® mirror set with enhanced aluminum coatings



10" f/6
60" (1524mm)
\$879

12.5" f/5
62.5" (1587mm)
***\$999**

14" f/4.5
63" (1600mm)
***\$1299**

17.5" f/5
87.5" (2222mm)
***\$1899**

*starting price

EQ REFLECTORS

- Parabolic primary and secondary mirror sets are manufactured and tested by Discovery
- Equatorial mount with Polar alignment scope
- 2 - 1.25" Plossl eyepieces
- Metal Rack & Pinion focuser
- Accessory tray
- R.A. Motor Drive included



6" f/5
30" (760mm)
\$499

8" f/5
40" (1016mm)
\$599

RFT-90 Traveler

- Short tube, Rich Field Refractor
- Full size and Table Top Tripods
- Equatorial head
- 10mm & 25mm eyepieces (1.25")
- 2x Barlow
- Heavy duty carrying case
- 45 degree erecting prism



90mm f/5.6
19.8" (504mm)
\$379

DHQ DOBSONIANS

- Parabolic primary and secondary mirror sets are manufactured and tested by Discovery
- Metal mirror cell design maximizes tube ventilation
- 2 - 1.25" Plossl eyepieces
- Metal Rack & Pinion focuser
- Adjustable Tube Bearings
- 4-vane spider
- 6x30 viewfinder



6" f/8
62.5" (1587mm)
\$299

8" f/6
75" (1905mm)
\$399

10" f/4.5
45" (1143mm)
\$569

10" f/5.6
56" (1422mm)
\$569

optional eyepiece shelf and digital setting circle shown

Ask for a Discovery Catalog showing our complete line of Telescopes, Optics and Accessories

Order toll free: (877) 523-4400

visit our website at:

www.discovery-telescopes.com

615 S. Tremont St. Oceanside, CA 92054 • tel: (760) 967-6598 • fax: (760) 967-6798

STATEMENT OF OWNERSHIP, MANAGEMENT, AND CIRCULATION

(Required by 39 USC 3685)

1. Publication title: ASTRONOMY
2. Publication No.: 531-350
3. Filing date: October 6, 2000
4. Issue frequency: monthly
5. Number of issues published annually: 12
6. Annual subscription price: \$39.95
7. Complete mailing address of known office of publication: 21027 Crossroads Circle, Waukesha, WI 53187-1612, Waukesha County.
8. Complete mailing address of general business office of publisher: same
9. Publisher: James J. Stocum, 21027 Crossroads Circle, Waukesha, WI 53187-1612; Editor: Bonnie Blyeu Gordon, same; Managing editor: David J. Eicher, same.

10. Owner: Kalmbach Publishing Co., 21027 Crossroads Circle, P. O. Box 1612, Waukesha, WI 53187-1612. Stockholders owning or holding 1 percent or more of total amount of stock are: Ruth H. O. Darragh, Rt. 8, Box 95, Harrison, AR 72601-8617; Harold Edmonson, 6021 N. Marmora Ave., Chicago, IL 60646; Susan Fisher, 1152 N. Paseo De Golf, Green Valley, AZ 85614-3604; George A. Gloff, c/o Ted & Lois Stuart, 1873 Frays Mill Rd., Ruckersville, VA 22968; Elizabeth K. Grunden, 10926 Leaning Ash Ln., Houston, TX 77079; Linda H. Hanson, 22134 Harbor Rd., Barrington, IL 60010; Robert L. Hayden Jr. &/or Gloria E. Hayden Survivorship Marital Property, 7 Hijo de Dios, Santa Fe, NM 87505; George F. Hirschmann Trust, 635 Glenridge Dr., Glenview, IL 60025; Booth & Co. for the George F. Hirschmann Trust, Northern Trust Co., 40 Broad St., 8th Fl., New York, NY 10004; Charles A. Kalmbach, 7433 N. Braeburn Ln., Glendale, WI 53209; Lois P. Kalmbach, 7433 N. Braeburn Ln., Glendale, WI 53209; Ruth Klinka Kalmbach, Trustee of the Sydney H. and Ruth Klinka Kalmbach Family Trust, Dated March 5, 1990, P. O. Box 727, Pebble Beach, CA 93953-0727; Kalmbach Profit Sharing/401K Savings Plan & Trust, P. O. Box 1612, Waukesha, WI 53187-1612; James J. King, 3874 Quail Ridge Dr., Boynton Beach, FL 33436; Mahnke Family Trust, 1979 Discovery Village Ln., Gold River, CA 95670-7279; Mahnke Family Limited Partnership, Dated July 8, 1996, 1979 Discovery Village Ln., Gold River, CA 95670-7279; Dan Haley as Special Independent Trustee of the Mahnke Charitable Remainder Trust #1, Dated July 8, 1996, 2035 Hurley Way, Suite #250, Sacramento, CA 95825; Walter J. Mundscha, N24 W30420 Crystal Springs Dr., Pewaukee, WI 53072-4275; Robcliff, Inc., P. O. Box 3597, Reno, NV 89505; David M. Thornburgh Trust, 420 W. San Marino Dr., Miami Beach, FL 33139.

11. Known bondholders, mortgagees and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages, or other securities: N/A

12. Tax status (for completion by nonprofit organizations authorized to mail at special rates): N/A

13. Publication title: ASTRONOMY

14. Issue date for circulation data below: September 2000

15. Extent and nature of circulation:

	Average no. copies each issue during preceding 12 months	Actual no. copies of single issue published nearest to filing date
A. Total number of copies (net press run)	262,146	255,201
B. Paid and/or requested circulation		

1. Paid/requested outside-county mail subscriptions 118,622 117,844

2. Paid in-county subscriptions N/A N/A

3. Sales through dealers and carriers, street vendors, counter sales, and other non-USPS paid distribution 52,875 50,258

4. Other classes mailed through the USPS N/A N/A

C. Total paid and/or requested circulation (sum of 15B1 and 15B2) 171,497 168,102

D. Free distribution by mail (samples, complimentary, and other free) 236 245

E. Free distribution outside the mail (carriers or other means) -0- -0-

F. Total free distribution (sum of 15D and 15E) 236 245

G. Total distribution (sum of 15C and 15F) 171,733 168,347

H. Copies not distributed 90,413 86,854

I. Total (sum of 15G and 15H) 262,146 255,201

L. Percent paid and/or requested circulation: 99.86% 99.85%

16. Publication of statement of ownership: Publication required. Printed in the January 2001 issue of this publication.

17. I certify that the statements made by me above are correct and complete. Michelle Spehr, Circulation Manager, Date: October 6, 2000

Astrophoto 35mm Camera!

Great for long time exposures!



\$179⁹⁵ camera only

8-Piece Acc'y Kit:

- Camera choice (see below)
- Carrying Case
- T-adaptor (specify scope)
- T-Ring
- 192-pg. Astrophotography Book
- Locking Cable Release
- 2-Rolls of Fuji 800 Color Film

Completely manual 35mm SLR! Mechanical shutter requires no batteries to operate at speeds from 1/2000 to 1 sec. plus "Bulb" setting for astrophoto time exposures. Hot shoe for flash connection. Accepts standard thread-in cable release. TTL light meter for conventional applications. Interchangeable Pentax-K lens mount!

Without 8-piece Acc'y Kit:

Body only (no lens)	\$179.95
Body w/50mm lens	219.95
Body w/35-70mm lens	239.95

With 8-piece Acc'y kit: **SAVE \$35!**

Body only (no lens)	\$279.95
Body w/50mm lens	319.95
Body w/35-70mm lens	339.95

SHUTAN camera & video

Toll-Free 800-621-2248 Illinois 847-367-4600

www.shutan.com

100 Fairway Dr. • Vernon Hills IL • 60061

SOLAR FILTERS

We offer a full line of full aperture and off-axis solar filters made from the famous BAADER AstroSolar film. This filter offers unsurpassed resolution and image quality. Photographic film available upon request.

TV Ranger	\$45
TV Pronto	\$45
C80	\$50
ETX 90	\$55
C102	\$60
Questar 3.5	\$63
AP 105	\$65
TV 101/102	\$65
C5/ETX 125	\$68
AP 130	\$70
AP 155	\$75
8" SCT	\$85
C9.25	\$110
10" SCT	\$120
C11 F/A	\$135
C11 O/A	\$85
12" SCT F/A	\$150
12" SCT O/A	\$95
C14 F/A	\$185
C14 O/A	\$105

Other sizes available

H-ALPHA FILTERS

We carry the full line of Coronado Instruments H-alpha filters and scopes. Call for pricing or visit our web site for details.

SUN FINDER

Unique tool for fast and easy centering of the sun in your eyepiece. Fits over your Telrad or any telescope tube up to 6" in diameter.

BUY DIRECT OR FROM YOUR FAVOURITE DEALER

POWER PACKS



12V 18 AMP HOUR

Comes with float charger, carry bag, built in fused cigarette lighter power socket.\$125.00

NEW!!! NEW!!! NEW!!! NEW!!!
18 AMP HOUR DUAL PLUG POWER PACK

2 fused plugs, Digital meter, .750 amp float charger, carry bag. Comes in two configurations, 12volt & 18 volt



18 volt...\$245

12 volt...\$175

33 AMP HOUR BATTERY

SAME AS 18 AMP HOUR BUT WITH 4 PLUGS AND MORE POWER! Comes in two configurations, 12 volt & 18 volt.

18 volt version is for LX 200 owners. One plug has a built in inverter for 18 volt output.



12 volt...\$290

18 volt...\$390

OBSERVING CHAIR



Ultimate II has a folding accessory tray for eyepieces, filters, charts etc.

Made from Baltic Birch Plywood.

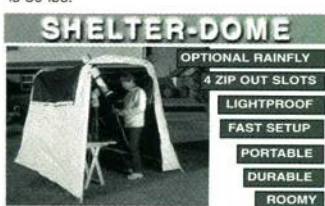
ULTIMATE II

ULTIMATE

OBSERVER TENT



Has two rooms. One for sleeping, another for your scope. This is a **BIG TENT**. The floor dimensions are 15' x 9' x 6' 6" (center height). Packs down to 45" x 8" x 8". Weight is 30 lbs.



Absolutely lightproof. White exterior, black interior. Interior floor dimensions are 10' x 7'. Packs down to 56" x 20" x 8". Weighs 30 lb.

SKY TENT



Unique portable observatory with a rotating dome. Set up in 30 minutes. Weatherproof, semi permanent. Various sizes and options. Call for pricing.



KENDRICK ASTRO INSTRUMENTS
2920 Dundas St. W., Toronto, ON M6P 1Y8, CANADA
TOLL FREE 1 800 393 5456 - PH 416 762 7946 - FAX 416 762 2765
ORDER ONLINE @ www.kendrick-ai.com email to: info@kendrick-ai.com

DEW REMOVERS

The world's best controller.....\$70.00
system for truly .965".....\$33.00
effective dew 1.25".....\$35.00
and frost control. 2".....\$38.00
Available for 3".....\$40.00
almost all optics 4".....\$43.00
used in amateur 5".....\$45.00
astronomy 6".....\$48.00
today. 7/8".....\$50.00
Thousands of 9/10".....\$60.00
systems sold. 11".....\$65.00
Telescope computer 12".....\$70.00
heater 14/16".....\$80.00
control 16".....\$83.00
heater 18".....\$85.00
heater 20".....\$88.00
heater 22".....\$90.00
heater 24".....\$93.00
heater 26".....\$95.00
heater 28".....\$98.00
heater 30".....\$100.00

DEW CAPS

Flexible, Felt lined, Durable. Save up to 85% vs Brand Name.

LASER COLLIMATORS

Laser collimators for SCTs, Newtonians, Mak Newts, Ritchey Chretiens, Mak Cass.

SCT laser	\$175
SCT NGF-S	\$190
2" Laser	\$110
1.25" Laser	\$100

KWIK FOCUS

A unique and easy to use focusing aid for observers, astrophotographers and CCDers. Get excellent results with little effort. Available for most commonly used amateur telescopes. \$30 to \$65.





Enthusiasts of astronomy, photography, and art will find wonders to behold in the works of David Malin, one of the world's leading astrophotographers. The forty-image exhibit, **"Night Skies: The Art of Deep Space,"** will be on display at the Newark Museum in Newark, New Jersey, **through February 25.** On loan from the National Academy of Sciences in Washington D.C., this series of large-scale photographs captures views of star clusters, nebulae, and galaxies taken by Malin, photographic scientist at the Anglo-Australian Observatory in New South Wales, Australia. Considered the best in the field, Malin's works provide important data on age, temperature, composition, and more. They also reveal the eye and hand of a master with their brilliant colorations, fantastic shapes, and overall haunting beauty. This free exhibition is being presented with support from the Geraldine R. Dodge Foundation and Qantas Airways. For further information, contact (973) 596-6529 or (973) 596-6355; website, www.newarkmuseum.org/planetarium.

JANUARY 27, FEBRUARY 16 Adler Astronomy Lectures

Adler Planetarium and Astronomy Museum, Chicago, Illinois. January 27, **Alexander Wolszczan, "Beyond Our Solar System: Discovery of Pulsar Planets."** Wolszczan's lecture is cosponsored by the Polish Consulate in conjunction with the exhibit **"The Remarkable Work of Copernicus, Hevelius, and Other Historic Polish Astronomers,"** on display through January 28. **Rocky Kolb** of the Fermi National Accelerator Lab and the University of Chicago will present **"Primordial Soup: A Little Taste of the Big Bang"** February 16. For more information, contact (312) 922-STAR; or view their website, <http://www.adlerplanetarium.org>.

THROUGH MAY 2001

Stargazing — 1,000 Years of the Art and Science of Astronomy

Huntington Library, San Marino, California. Exhibition presented by the



Ron Zinecone

The chill of winter often accompanies pristine skies, setting the stage for heart-warming nights of stargazing.

Huntington Library and NASA's Jet Propulsion Laboratory. For more information, contact Randy Shulman, (626) 405-2293; fax, (626) 449-5656; e-mail, rshulman@huntington.org; website, <http://www.huntington.org>.

JANUARY 7-11

Winter Meeting of the American Astronomical Society

San Diego, California. Held jointly with the American Association of Physics Teachers. For information on scientific programming or exhibit information contact Diana Alexander, (202) 328-2010; e-mail, diana@aaas.org; for registration information contact Millie Durbin, (202) 234-7850; e-mail, reg-help@aaas.org; AAS website, <http://www.aaas.org>.

JANUARY 9

AAS Second Century Lecture Series — Andrea Ghez: Unveiling a Black Hole at the Center of the Milky Way Galaxy

Reuben H. Fleet Science Center, San Diego, California. For more information, telephone, (619) 238-1233.

JANUARY 18-21

Highlands Stargaze

Nine Mile Grade Campground, between Sebring and Okeechobee, Florida. Three nights of observing, guest speakers, door

prizes, and a barbecue in a beautiful setting with some of the darkest skies in south-central Florida. Contact Richard Lindblom, (863) 655-0131; e-mail, lindblom@ct.net; website, <http://stargaze2001.cjb.net>.

JANUARY 22

Hayden Planetarium Lecture

New York, New York. **David Helfand, Chandra: The X-ray Universe Revealed.** For more information, contact the Hayden Planetarium at (212) 769-5900; website, <http://www.amnh.org/education/hayden.html>.

FEBRUARY 19-25

Winter Star Party

Camp Wesumkee, West Summerland Key, Florida Keys, Florida. Sponsored by the Southern Cross Astronomical Society. Advance registration is required. For information, contact registrars Fred & Lucille Heinrich, 6165 Wiggins Road, Live Oak, FL 32060; (904) 362-5995; fax, (904) 362-5996; e-mail, Heinrich@atlantic.net; website, <http://www.scas.org>. For information about accommodations call (800) FLA-KEYS.

FEBRUARY 21-25

Orange Blossom Special Star Party

Hickory Hill Observing Compound, near Brooksville, Florida. Sponsored by

the St. Petersburg Astronomy Club. Contact Dennis or Ellen Farr, 8811 W. Broad Street, Tampa, FL 33615; (813) 884-9111; e-mail, DneFarr@aol.com.

MARCH 17-26

Astronomy's Northern Lights Tour of Alaska

Chase the colorful curtains of the aurora borealis through Alaska's interior with *Astronomy* magazine. We will spend five nights in Fairbanks, then continue to Chena Hot Springs, far from light pollution. The evening aurora should produce an impressive show as solar activity is expected to be high at this time. During the day, you can take advantage of cross-country skiing, snowshoeing, and ice-skating, or relax in the world-famous hot springs. Whatever your choices for the daylight and evening hours, pack your warm clothes and join *Astronomy* on this watch for the magical northern lights in the heart of Alaska. For more information, call Specialty Tours at (800) 677-9412 or (727) 796-7555; or e-mail, gs@alspecialtytours.com.

MARCH 23-26

South Pacific Star Party

Wiruna, near Ilford, NSW, Australia. Hosted by the Astronomical Society of New South Wales, this is the largest amateur astronomy event of its kind in Australia. For more information, contact Les Sara, e-mail, Secretary@asnsw.com; website, <http://www.asnsw.com>.

MARCH 31

Queensland Astronomy Education Conference

Queensland, Australia. Biannual educators' conference targets the teaching of astronomy and astronautics in primary and secondary schools. Variable program includes portable planetarium sessions, lectures, workshops, and nighttime observing. Contact Paul Floyd, e-mail, ssemps@ozemail.com.au; website, <http://www.ozemail.com.au/~ssemps/confer/index.html>. **A**

CONTACT

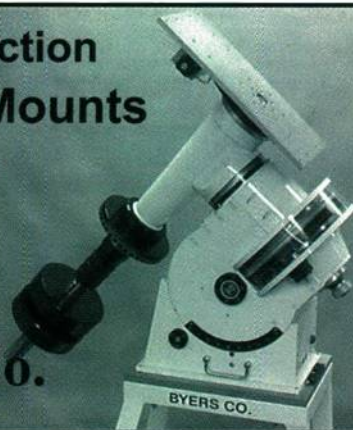
Please submit club announcements four months in advance to Looking Ahead, *Astronomy*, P.O. Box 1612, Waukesha, WI 53187, or to tconley@astronomy.com. Look for additional events at <http://www.astronomy.com>.

New Year 2000 production BYERS Series II Mounts

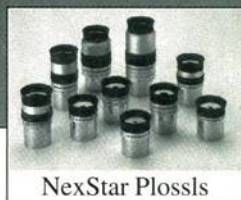
Research quality.
With analog circles
(as shown) or digital
position display. (See at
www.hardin-optical.com)

Hardin Optical Co.

Call toll free: 1-877-447-4847



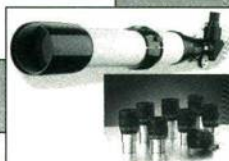
the right stuff. at the right place for the right price



NexStar Plossls



Books
Sky Charts
Software
Astronomical
Binoculars



New Tele Vue 102
& Radian Eyepieces



Meade ETX

NEW Celestron NexStar 8!



Complete GOTO Telescope with 18,000+ object database.
Includes 50X Plossl eyepiece, AC Adapter, Star Diagonal,
Star Pointer finder and Adjustable Aluminum Tripod.
All for only \$1699.00!

Telescopes * Binoculars * Eyepieces * Filters * Tripods/Mounts
Dec/Focus Motors * Sky Maps/Books * Star Pointers/Finders
Complete Selection of Telescope Accessories

EAGLE OPTICS

(800) 289-1132

www.eagleoptics.com

2120 W. Greenview Dr. #4 Middleton, WI 53562



Welcome to the MARKETPLACE section in ASTRONOMY Magazine. These pages are specifically designed to be an affordable and highly effective way for you to market astronomy-related products or services. Call Michael Ellis at 888-558-1544, ext. 636 to place your advertising message here.

Starsplitter Telescopes

Quality Focused on the Customer!



Starsplitter II
15" - 40"
Compacts
8" - 15"

We offer the largest selection of Newtonian telescopes on the market today!

Please send \$2.00 for a catalog. Online catalog at www.starsplitter.com



Starsplitter Tube
6" - 10"
APO - Eater
6" f/10 & 8" f/8

Starsplitter Telescopes
3228 Rikard Drive
Thousand Oaks, CA 91362
805-492-0489 Phone & Fax
www.starsplitter.com

THE AMAZING DOB DRIVER II



Dual axis microstep quartz drive fits all Dobsonians, or user-built equatorials. Powerful computerized tracking, panning, and guiding in the palm of your hand! Super portable, super simple, AC/DC/CAR/BAT 12V. Instant setup-NO ALIGNMENT! Multi-function display. Calibration supertunes your scope to maximum performance. Options for PC link/CCD link.

New Roboscope PC Software
Go to 13,000+ objects + any chart point

Control only - \$349 ATM System - \$510
Complete system w/ready-to-install drives - \$599
Free catalog - satisfaction guaranteed!

TECH2000

3349 SR99 S Monroeville, OH 44847
Ph. 419-465-2997 • Fax 419-465-2484
www.accnorwalk.com/~tddi/tech2000

new. mexico skies



GUEST OBSERVATORY

☆ Spectacular Skies

DARK Steady Mag 7+ skies
Great Seeing - 7300' elevation
Near: Apache Point & Sunspot

☆ Great Equipment

16"/12" Meade LX 200
14" Celestron / Paramount
7" Astro Physics APO
30"/25"/15" BIG Dobs
Full line SBIG CCD cameras

☆ Modern Accommodations

Full size kitchens / 3-2-1 bedrooms

Mike and Lynn Rice, Astronomers

www.nmskies.com
info@nmskies.com

Phone: 505-687-2429/Fax: 505-687-3710
P. O. Box 559, Cloudcroft NM 88317

Immediate shipment

GREEN Laser Pointer

Green Beam is visible in the dark.

Very useful for instructors pointing out stars to students.

Range 1-2 miles

Power <5mW

Handsome, custom wood case.

90 day warranty

laserpointer.net

\$275

Brightest legally available

800 840-7829

Shipping 4.95

Overnight 19.95

VISA MC DISC AMEX

Astronomy

WE HAVE THE RIGHT ANSWER

Advertisers who want to place their print ads in a quality publication ask the question: "Is your circulation audited?"

We're very proud to answer "Yes."

We are a member of the Audit Bureau of Circulations because we share ABC's belief that circulation audits are an essential assurance of value.

ABC is the premier circulation auditing organization in the world and has been since 1914. Each year, ABC auditors test and verify that our circulation figures are facts, not claims. An ABC audit is the sign of a sound investment for advertisers.

Not all publications are audited, but they should be. Because when advertisers ask "Is your circulation audited?" there's only one answer.

"Yes."



Audit Bureau of Circulations

EUROPE'S PREMIER WEBSITE

<http://www.scsastro.co.uk>



AFRICAN ECLIPSE 2001

from 3-17 days

Primary Observation site, ZAMBIA

ECLIPSE CRUISE 2002

Sydney - Melbourne - Adelaide - Hobart
Join BUZZ ALDRIN & Steve Last



TRAVEL WIZARD

7788 University Ave., La Mesa, CA 91941

1-800-708-7677

(619) 464-1946 • FAX: 462-5278

glow in the dark eclipse T-shirts & patches

www.travelwizardtravel.com

The SCT Cooler



kills heat pillars

& tube currents - FAST!

Schmidt-Cassegrains and Maksutovs

slashes cool-down time

no scope modifications required

CosmicOne Digital Setting Circles

Astronomy Products Tripod Stabilizers

(888) 737-5050 Binocular Mounts

Celestron - Meade - TeleVue

Lymax's Earth, Sky, & Astronomy

13008 E. US 40 Hwy, Independence, MO 64055

www.Lymax.com

THE WANDERERS ORRERY



CORRECT
RELATIVE
MOTION
OF ALL
NINE PLANETS

SEMI-PRECIOUS
STONES DEPICT
PLANETS AND SUN

BATTERY
OPERATED
\$195.00
+ S & H

WARRANTY
AND
MANUAL
INCLUDED

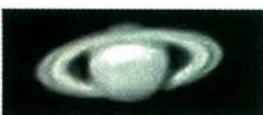
SCIENCE ART CO 800-238-7310 scienceartco.com

Marketplace

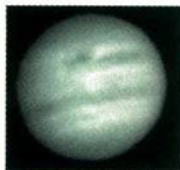
Bargain Books

Edward R. Hamilton, Bookseller
Shop America's *biggest* catalog selection, save up to 80%. **Astronomy**, Science, Computers, Photography, much more. Hundreds of new arrivals monthly.
Free Catalog: 1-800-677-3483
— www.erhbooks.com/bmv —

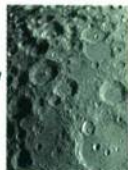
Entry level CCD imaging
Includes camera, software and everything needed for prime focus & eyepiece projection in 24 bit color
407-259-6498



SAC
P.O. Box 360982
Melbourne, FL 32936
wsnyder@sac-imaging.com



**SACIV
\$224**



www.sac-imaging.com

Lacking a co-star?

Meet him or her through the network for single science/nature enthusiasts:



Science Connection

800-667-5179
www.sciconnect.com

Star Hill Inn

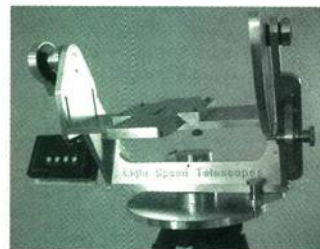
an astronomy retreat in the Rockies

Experience a unique dark sky vacation. Stay in charming private cottages on hundreds of acres of peaceful pines. 7200' elevation. Star tours, telescopes for rent, or use your own at our observatory. Astronomy, Birding and Art Workshops. Easy access to Santa Fe, Taos, Pecos Wilderness, Wildlife Refuges & Ski Resorts.

Open all year. For info:

Star Hill Inn
Sapello, New Mexico, 87745
505-425-5605
www.starhillinn.com

Hitch this Wagon to a star...



THE WAGON MULTI-PURPOSE MOUNT

Light Speed Telescopes, Inc.

<http://home.att.net/~Riddel.LightSpeed>
Riddel.LightSpeed@worldnet.att.net

NEW AUTHORS

PUBLISH YOUR WORK
ALL SUBJECTS CONSIDERED
WRITE, OR SEND YOUR MANUSCRIPT TO:
MINERVA PUBLISHING CO.
1001 BRICKELL BAY DR., # 2310, MIAMI, FL 33131

CELESTRON
Firstscope 80 - \$299.99

Firstscope 114 - \$349.99

MEADE
DS-70EC - \$349.99

ETX-60AT - \$299.99

no need to

SEARCH THE SKY

for your equipment

Celestron
Nextstar 60GT - \$299.99
G5 with motor drive - \$749.99
Celestar 8 - \$1099.99

Meade
DS-114EC - \$399.99
DS-90EC - \$499.99
ETX-90EC - \$595.99

AES

5710 W. Good Hope Rd • Milwaukee, WI 53223
Local line: (414)358-0333 • info@aesham.com

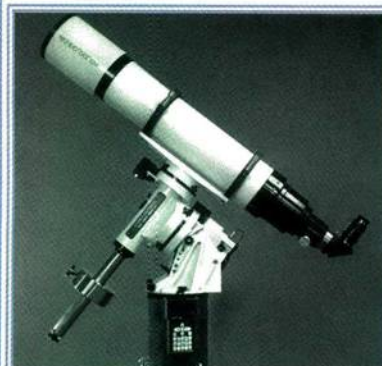
1-800-558-0411

www.aesham.com

ASTRO-PHYSICS

High-quality instruments for discriminating observers and astrophotographers

Refractors- 105,130,155 mm dia.
Go-To German Equatorials
Visual and Photographic
Accessories



155 Starfire EDFS with 2.7" Focuser,
900GTO German Equatorial
Accessories

11250 Forest Hills Rd.
Rockford, IL 61115 USA

Ph: 815-282-1513, Fax: 815-282-9847
www.astro-physics.com

Astronomy's Marketplace

**8" f/6 • 10" f/5
12.5" f/5
14.5" f/4.3**



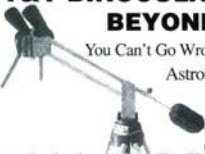
**Think Outside
Of The Box**

Mag 1 Instruments Portaball
Quick Set-up • Rotatable Tube
Optics by Zambuto Optics

SEE
It Spin
Online!

mag1instruments.com
262-785-0926

**T&T BINOCULAR MOUNTS &
BEYOND LLC**



You Can't Go Wrong with T&T ARTI Mount!
Astronomy rated it BEST BUY
of 2000! \$205 (plus s+h)
18 Strong St. Extension
East Haven, CT 06512
(203) 469-2845 or (203) 272-1915
E-mail: TELLOYD@aol.com

www.benjaminsweb.com/TandT

METEORITES



Own a piece of another world!
Free Catalogue and Mailings
New England Meteoritical Services
Box 440-A, Mendon MA 01756 USA
Tel 508-478-4020 Fax 508-478-5104
www.TouchAnotherWorld.com

Wired • Wireless • Solar

Weather Instruments

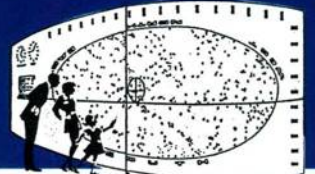


**Weather
Warehouse**

At Wholesale Prices

www.weatherwarehouse.com

Buy a Star ★ Name a Star



On the exclusive MSAS Star Atlas
Soon to be placed in the newly opened MSAS Astronomy Village
Receive a certificate of record and more...
Starting at only \$25.00

(909) 336-1699

http://www.mountain-skies.org
Mtn. Skies Astronomical Society-Box 1169 - Lk Arwhd, CA. 92352

www.novaspace.com



SPACE ART



**Hardin
Optical
Company**

Telescopes, Binoculars,
Mounts, Eyepieces
and Accessories
for the astronomer
on your gift list.

**Celestron • Meade • Tele Vue
Astrola Mirrors • Bushnell
Brunton • Leupold • Nikon
Byers • Leica • Losmandy
Takahashi • JMI • Fujinon
and many other quality brands**

call 1-877-447-4847 toll free
or visit our online store at
HardinOptical.com

Add The Eclipsers, safe solar glasses, to the top of your Christmas list!
On Dec. 25, 2000, a partial solar eclipse will be visible throughout North America and Canada. The only safe way to view solar eclipses is with Eclipsers safe solar glasses from American Paper Optics. CE certified, independently tested, and safe for direct solar viewing. Eclipsers are manufactured exclusively with Solar Screen® lenses developed by astronomer Roger Tutthill. American Paper Optics has sold over 10,000,000 Eclipsers throughout the world over the last ten years.



Eclipsers, colorfully printed with our commemorative Christmas design, are great stocking stuffers for clubs, enthusiasts, and organizations. Eclipsers are a spectacular retail sales item for science centers, museums, and planetariums. Custom-printed designs are also available for promotional use—call us for a quote! **Order Christmas Eclipsers today! 50 pairs @ \$1.79 each plus shipping.** Place your order three convenient ways: via our toll-free line at (800) 767-8427, by fax at (901) 381-1517, or email your order to sales@3dglasseonline.com.

**AMERICAN
PAPER OPTICS**
3000 BARTLEY CORPORATE DRIVE
BARTLEY, TENNESSEE 38003
www.3dglasseonline.com
1-800-767-8427 • 901-381-1515 • FAX 901-381-1517

**TELESCOPE KITS, LENSES, ACHROMATS
MIRRORS, MIRROR BLANKS,
ALUMINUM COATINGS & ACCESSORIES**

BUY DIRECT ★ DO IT YOURSELF

Stock & Custom mirrors and molded mirror blanks, diagonals, parts made from Pyrex, optical glasses, fused silica, quartz and other low expansion ceramic materials. Telescope accessories, do-it-yourself books.

Write, call, fax or e-mail for catalog

NEWPORT GLASS WORKS, LTD.
P.O. Box 127
Stanton, CA 90680
PH: (714) 484-8100
FAX: (714) 484-8181
E-mail: astronomy@newportglass.com
Web: http://www.newportglass.com



**Howie Glatter's
Laser Collimators** announces:

A 5mw Green (532nm) high visibility laser pointer that's perfect for pointing out celestial objects to groups of people under dark sky conditions.



SkyPointer®
\$235+\$5 S&H

And...the finest Laser Collimators in this Solar System



Shockproof Laser Alignment
Solid Aluminum and Stainless construction
Accurate to 0.0002"

Single Beam Collimators From \$100
Holographic Collimators From \$150

Major price cut on Ultra-Bright Green Holographic Laser Collimators - Now \$350+\$5 S&H

All Collimators supplied with an accessory small aperture stop
Howie Glatter 3850 Sedgwick Ave. Bronx, N.Y. 10463
Tel/Fax (718) 796 3203
www.skypointer.net www.collimator.com
e-mail: howieglatter@mindspring.com

Astronomy's Marketplace

ROME TELESCOPE CORPORATION
Astronomy Products

Telescopes - Tripods - Accessories
(All Major Credit Cards Accepted)

P.O. Box 0312, Oak Creek, WI 53154
PH# 414-764-6890 www.rometelescope.com

METEORITES!
Irons, Stones, Stony-irons, Tekites.
Quality display and study specimens.
Space jewelry, books, slides.
Authenticity guaranteed.
Color Catalog \$2.

Bethany Sciences
P.O. Box 3726-A
New Haven, CT 06525
★ CATCH A FALLING STAR! ★
(203)393-3395

Africa Solar Eclipse
Zambia, Zimbabwe
June 13-25, 2001
• Limited to 26 Participants •

- Best viewing site on the eclipse path
- Game drives in Zambia and Zimbabwe
- See Victoria Falls
- The smallest eclipse group around

Outer Edge Expeditions
800-322-5235 • 517-552-5300
adventure@outer-edge.com

STAR TEK
FINE ASTRONOMY PRODUCTS

See our '3-in-1' tray and other new products at
www.startekind.com

Toll Free: 888-416-9480 Pat. Pend.

Uniquely Personal Valentine Gift!
Show Your Loved One What You Think Of Your Special Date With An Artistic Rendering Of The Cosmos.
Capture The Night.
www.anycosmicnight.com

Schmidt Cassegrains
Refractors & Reflectors
Maksutovs, Apochromats
Solar, Color & Nebula Filters
Binoculars & Spotting Scopes
Widefield & Planetary Eyepieces
2" Diagonals, Eyepieces, Filters
Camera Adapter, Focal Reducer
Beginners & Advanced Scopes
CCD Hardware and Software
Photo Accessories, Software
Mounts, Drives, Computers
Computerized Telescopes
Finders and Focusers
Mirrors and Lenses
Appraisals, Repair
Tons of Used Stuff

Hands on Optics
New Store Location
26437 Ridge Rd (Rt.27)
Damascus, MD 20872
301-482-0000
www.handsonoptics.com

PARFOCAL BRANDON® OCULARS



Effective focal lengths: 8, 12, 16, 24 and 32mm

STEP UP TO BRANDON!

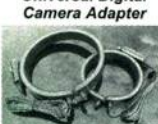
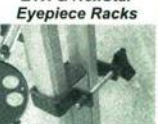
#1 for Contrast

VERNONSCOPE & company
Division of
Gould Precision Optics Inc.

151 Court Street
Binghamton, NY 13901
Toll Free in US
888.303.3526
607.722.5697
607.722.7939
www.vernonscope.com

SCOPETRONIX PHONE/FAX
QUALITY ASTRONOMY PRODUCTS (941)945-6763

ORIGINAL EQUIPMENT AND AFTERMARKET
ACCESSORIES FOR ETX / NEXSTAR / LX SCOPES

 LX50 "Dec Fix Kit" Improves Performance	 Low Cost-High Quality Plossl Eyepieces	 Joystick for LX200/Magellan II	 ETX & NexStar Astro 300 Tripods	 Celestar 8 & LX10 Astro 600 Tripod
 Universal Digital Camera Adapter	 ETX & NexStar Piggyback Mounts	 WE ACCEPT: DISCOVER VISA MasterCard	 Flexi-Focus™ for the ETX	 ETX & NexStar Eyepiece Racks
 The "Dew Clip" Dew Heaters	 The "Light Sight" Red Dot Finder	 ETX & NexStar Photo Tripod Adapters	 LX10/50 Deluxe Latitude Adjusters	 Tripod Leg Clamps Fits ETX & Others


ScopeTronix Products are also available at these fine Retailers:
Sky Works - Tucson, AZ
Mike's Camera, Inc. - Boulder, CO
Shutan Camera & Video - Chicago, IL
Astronomy World UK Ltd. - Hampshire, England
Oceanside Photo and Telescope (OPT) - Oceanside, CA

WE STOCK MEADE, CELESTRON, TELEVEU, ATELE/LOMO, JMB, RIGEL, STARBOUND, CKC, & MUCH MORE!

24 HOUR ONLINE SHOPPING & SECURE ORDERING
WWW.SCOPETRONIX.COM

Retail & Travel Directory

The Directory is designed to be a quick and easy way to locate astronomy-related retail stores, activities, planetariums and observatories. To advertise call toll free 1-888-558-1544 ext. 487

RETAIL SHOPS

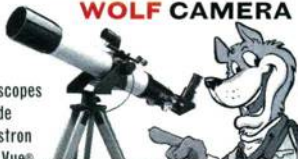
ARIZONA - Phoenix 85032

THE ASTRONOMY SHOPPE

Telescopes (Meade, Celestron, Tele Vue®, Orion, Takahashi) • Spotting Scopes • Binoculars
Eyepieces & Accessories • Maps • Books • Sky Tours
We welcome mail orders. Visa/MasterCard accepted.
astroshop@earthlink.net www.darkskyinc.com
3202 E. Greenway Rd. Suite 1615 (888) 999-6396

Say you saw their Retail Directory Ad in **Astronomy!**

FLORIDA - Sarasota 34236



WOLF CAMERA

Telescopes
Meade
Celestron
Tele Vue®

CCD Equipment
Meade Pictor
Optec Max.
Accessories

The Largest Telescope Dealer in the Southeast!
New & used telescopes, CCD equipment & accessories, plus a huge selection of eyepieces and binoculars! Call Chuck Pisa our staff Astronomer with 20 years experience today!

www.wolfcamera.com Fax: (941) 952-0278

1055 S. Tamiami Trail (941) 957-4686

GEORGIA - Atlanta 30306

CAMERA BUG

TELESCOPES • BINOCULARS • ACCESSORIES
EYEPIECES • SPOTTING SCOPES • MAPS • BOOKS

Canon • Celestron • Meade • Minolta • Olympus
Orion • Pentax • TeleVue® • Telrad • Rigol

WE SHIP ALMOST ANYWHERE!

www.camerabug.com

Fax: (404) 873-3925

Orders Only: (800) 545-8509

1799 Briarcliff Rd. (404) 873-4513

NEW MEXICO - Belen 87002

MA NEW MEXICO ASTRONOMICAL
BEFORE YOU BUY... COME TO THE COUNTRY AND
TEST TELESCOPES UNDER DARK SKIES!

Full range of sizes on display in our showroom!

Telescopes • Spotting Scopes • Binoculars • Eyepieces

All major brands. www.nmastronomical.com

834 N. Gabaldon Rd. (505) 864-2953

NEW YORK - Amityville 11701



TELESCOPES • BINOCULARS • CAMERAS

We Carry: Meade • Celestron • Swarovski

Leica • Zeiss • Steiner • Fujinon • Pentax

Bausch & Lomb • Bushnell • Nikon • Canon

Catalog Available • We Ship Nationwide

http://www.berger-bros.com

Phone: (631) 264-4160 Fax: (631) 264-1007

209 Broadway (Route 110) (800) 262-4160

RETAIL SHOPS

TEXAS - Dallas 75252

THE OBSERVATORY, INC.

The Most Complete Telescope Store in Texas

TELESCOPES • MICROSCOPES • BINOCULARS

In the field set-up & instruction with every
Astronomical Telescope purchase
Astronomical Telescopes • Spotting Scopes
Binoculars & Giant Binoculars • Sky Charts
Atlases, Books • Computer Controlled Telescopes
Astronomy Software

Celestron, Meade, Orion, Tele Vue®, Geochron,
Canon, Swift, Spherical Concepts, Fujinon
Home-Dome by Technical Innovations

www.TheObservatoryInc.com

19009 Preston Rd, Suite 114 (972) 248-1450

TEXAS - Fort Worth 72126

SKYWATCH PRODUCTS

North Texas' Most Affordable
Telescope and Accessories Source
Look Through (day or night) before buying.
Knowledgeable and friendly staff. Extensive showroom
inventory. Astronomy classes available.
Shipping available. Fax (817) 249-5762.
http://members.aol.com/skywatchpr/home.html

7600 Benbrook Pkwy. #5 (817) 249-3767

TEXAS - San Antonio 78250

**Analytical Scientific**

"The Source For All
Your Astronomy Needs"

Visit our showroom and see the largest selection of
telescopes in Texas. Meade, Celestron, Tele Vue®.

Telescopes, binoculars, microscopes, spotting scopes,

accessories, books, charts, posters.

Science, nature and educational items.

E-Mail: asltd@analyticalsci.com

http://www.analyticalsci.com Fax: (210) 520-3344

11049 Bandera Rd. (800) 701-STAR (7827)

CANADA - Ontario - Toronto M6A 2T2

Shop on-line at **www.khanscope.com****MEADE APD PRODUCTS**

Our 14th Year!

NEW!!
MEADE 8" LX90



Celestron • Meade • Tele Vue® • Skywatcher
Binoculars • Spotting Scopes • Books,
Software • Low Prices

All Major Brands on Display

We Welcome trade-ins, Buy Used, Repairs & Service.

Toll Free (800) 580-7160

KHAN SCOPE CENTRE Ph. (416) 783-4140

3243 Dufferin St. Fax (416) 783-7697

When traveling, use the
Retail & Travel Directory
as your guide.

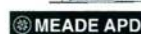
RETAIL SHOPS

CANADA - Ontario - Toronto M6A 3A4

EfstonScience

SERVING OBSERVING SINCE 1970!

Just look for the giant telescope on our roof!



Science & Astronomy Superstore.
All major brands on display. Free Literature.
We welcome trade-ins, buy used, do service.
Dobsonians in stock: 6" - 17 1/2"

www.e-sci.com Fax: (416) 787-5140

3350 Dufferin St. (416) 787-4581

TRAVEL

CALIFORNIA - Ridgecrest 93555

MAYHUGH TRAVEL'S ASTRONOMY VACATIONS

2001 ECLIPSE LAND CRUISE

2001 ECLIPSE SAFARI

Lowest Prices Guaranteed!

http://www.mayhugh.com

cst# 2049910-40

701 Perdew Ave. (888) 412-5317

KANSAS - Shawnee Mission 66205

www.AstronomicalTours.net

ASTRONOMICAL TOURS

•Zambia & Madagascar Eclipse 2001•

Alaska Aurora Expeditions

•Shuttle Launches / Space City•

Southern Skies Star Party

4907 W. 57th Terr. (913) 432-4636, toll free (888) 734-0311

As important as a
telescope is to
amateur astronomers!



Reach your
sales goal
with a
classified
ad in

Astronomy.

To place your ad, call today.

1-888-558-1544, ext. 815

Classifieds

This section is open to anyone who wants to buy astronomy-related merchandise. **RATES:** \$1.56 per word. Minimum charge is \$14.00 per issue. Prepayment required. Frequency discounts available. All copy is set in standard typography. **CLOSING DATE:** 1st of the month, three months before the cover date (i.e., March 1st for the June issue). Send your ads to *Astronomy*, Classifieds, PO Box 1612, Waukesha, WI 53187-1612. 1-888-558-1544 ext. 815. Major credit cards accepted.

ACCESSORIES FOR SALE

Altazimuth platform kits for large dobsonians up to 250 lbs. Digital setting circle kit. Serial EZtracker finds faint objects. Equatorial platform kits. TL Systems, 2184 Primrose Avenue, Vista, CA 92083. (760) 599-4219. tlssystem@ix.netcom.com or <http://www.netcom.com/~tlssystem/>

Green laser pointer, beam visible at night, ideal for pointing out stars. Much brighter than red lasers, range up to two miles. Handsome, wooden case. Immediate delivery. \$275.00 (800) 840-7829. E-mail: dean2@uswest.net website www.laserpointer.net/greenlaspoint.html

Visiting Hawaii? Maui Skies offers star charts, planispheres and other products to enhance star-gazing in Hawaii, plus lots of information. Visit <http://www.maui skies.com> or call toll-free: 877-211-8669.

BINOCULARS FOR SALE

Do you have BIG EYES? We have eyes for the stars, the sea, the mountains and more! (914) 944-3391 www.tquestoptical.com

PUBLICATIONS AND WEB SITES

Astronomer's Emporium. Buy, sell, trade your equipment. Place your ad for \$1.00 a word. \$30.00 per year subscription. 908 O Street, Auburn, NE. 68305

Authors Needed for Kidsastronomy.com We will be developing a children's encyclopedia of astronomical terms. For more information please visit <http://www.kidsastronomy.com/spacelopedia.htm>.

COSMIC PERSPECTIVE, Revolutionary cosmology treatise, reveals big bang fallacy: www.webservr.com/science

NEW BOOK on STAR OF BETHLEHEM, a supernova in Aquila. \$10.00 postpaid. www.starofmagi.com

LODGING/TOURS/TRIPS

Ecuador February 2001 with Greg Butcher and Paul Greenfield. BIRDER'S WORLD Magazine is sponsoring a special trip. Join us for one, two or all three segments: Amazon at Sacha Lodge, February 8-12; Andes, San Isidro Lodge and Hotel Tinalandia, February 12-17; Galapagos, February 17-27. For more details, contact Voyagers International (800) 633-0299 e-mail: explore@voyagers.com

Join ASTRONOMY Magazine on an African Eclipse Safari. Zimbabwe - June 10 - July 1, 2001. See the splendors of the sky while on a safari! Enjoy every second of the three-minute eclipse in a cloudless African sky. You'll share the experience with lions, elephants, buffaloes, hippopotamuses, impalas, and crocodiles, and witness the fascinating effect the eclipse has on these creatures. Choose the tour that best fits your personal schedule: June 10 - June 23, 2001 or June 19 - July 1, 2001. Both magnificent excursions include a fantastic view of the eclipse in a massive sky; first rate accommodations- both in the city and on the safari; a trip to the breathtaking Victoria Falls; and so much more. Join ASTRONOMY editors for an amazing adventure of a lifetime! Space is limited-don't delay! For more information, call Specialty Tours toll free (800) 677-9412, (727) 796-7555 or e-mail gs@alspecialtytours.com

Stargazing Yacht Charters in the Virgin Islands. Private luxury cruises for 2-4, specifically designed for amateur astronomers and their friends. See the jewels of the southern skies in pristine conditions. www.yachtgannet.com, e-mail: enri@viaccess.net

MISCELLANEOUS FOR SALE

Oversized, b&w, solar system primer poster, Copius Illustrations. Pennyproductions.com

ANNOUNCEMENTS/OPPORTUNITIES

Midwest Birding Symposium 2001 is winging its way to Wisconsin! Mark your calendars now for the 2001 Midwest Birding Symposium (MBS), Thursday, August 30 through Sunday, September 2, 2001. Hosted by BIRDER'S WORLD Magazine, EAGLE OPTICS, & the WISCONSIN SOCIETY FOR ORNITHOLOGY. The symposium will offer a varied menu of speakers and field trips of the state, Green Bay is surrounded by wetlands that vary from Lake Michigan shoreline to cattail marsh and sedge meadow. The area lies along major pathways for fall migrants. The theme of Wetlands and Wetland Species will ring through the week-end of activities that will include birding field trips, visits to nature centers, museums and bay cruises. The roster of renowned keynote speakers continues to expand. The symposium will be held at the Regency Suites Conference Center in downtown Green Bay. For accommodations, call (800) 236-3330 and request the special MBS room rate. The Green Bay Area Visitors and Convention Bureau can be reached at (920) 494-9507 for lists of alternative lodging. Sponsors to date include Swift Instruments, Leica Sports Optics, Swarovski Optics, the Green Bay Area Visitor and Convention Bureau, and the Mosquito Hill Nature Center. Additional information can be found on the BIRDER'S WORLD Web site: www.birdersworld.com. For questions or registration, please contact Bill Hubert at (800) 558-1544 ext. 236; by fax at (262) 798-6592 or by e-mail at bhubert@kalmbach.com.

TELESCOPES FOR SALE

For Sale: Meade 10 inch Dobsonian telescope \$350, ST-5C CCD camera \$650. Tele-vue Plossl eyepieces 8mm, 11mm, 15mm, 25mm, 32mm \$250. Hibbing, MN (218) 262-5114.

TELESCOPES WANTED

Wanted: used telescopes and accessories. Contact Gary Hand, 24045 Sugarcane Ln., Gaithersburg, MD 20882. (301) 253-5046.



Put the
spotlight on

YOUR COMPANY

with a display classified in
our Retail & Travel Directory.

Call Kristi Kohlhaugen

Toll-free at
888-558-1544, ext. 487
for more information.

JOIN *Astronomy* MAGAZINE ON A

Northern Lights Tour

Alaska:
March 17-26, 2001

Chase the colorful curtains of the aurora borealis through Alaska's interior with *Astronomy* Magazine. Along with catching one of the most spectacular views of the night sky, you will experience the magnificent vistas of a great, unspoiled wilderness.

Our experience begins with five nights in Fairbanks, one of Alaska's major urban centers that still maintains a pioneering spirit. You can arrange to shop, downhill ski, attend the Ice Festival, or simply curl up with a good book.

The adventure continues in Chena Hot Springs, 60 miles from Fairbanks, and far from light pollution. The evening aurora should produce an impressive show as solar activity is expected to be high in March 2001. During the day, you can take advantage of cross-country skiing, snow shoeing, and ice-skating. Or relax in the world-famous hot springs.

The breathtaking scenery is guaranteed to put you on sensory overload. Whatever your choices for the daylight and evening hours, pack your warm clothes and join *Astronomy* on this watch for the magical northern lights in the heart of Alaska. See you there!

**For more information call
Specialty Tours today at:
1-800-677-9412 (US only) or 727-796-7555
www.alspecialtytours.com**

Space is limited - don't delay!

"Stunning . . . poetic in feeling, as vast as a voyage through outer space."
—John Cornwell, *Sunday Times*

Stardust

Supernovae & Life—

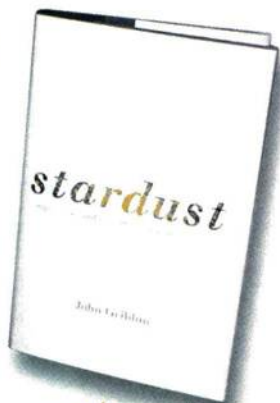
The Cosmic Connection

JOHN GRIBBIN

"A fascinating account of the long evolution of chemical matter undergoing transformations in stars."

—Lynn Margulis
22 illus. \$24.95

Also available by John Gribbin:
The Birth of Time
How Astronomers Measure the Age of the Universe
\$22.50



Yale University Press  www.yale.edu/yup

ASTROPTX

8" SCH/CASS O.T.A. \$599 TEL RAD & DEW SHLD \$35.00
9 1/4" SCH/CASS O.T.A. \$999 (4) COLOR FILTER 1 1/4" \$33.00

Celestron ★ Meade ★ B&L
Telescopes-Binoculars-Accessories

LOWEST PRICES

Tel: (860) 355-3132

Phone Orders

9am to 9pm (7) Days

Fax: (203) 746-3579 (24) Hrs

57 North Street #401

Danbury, CT 06810

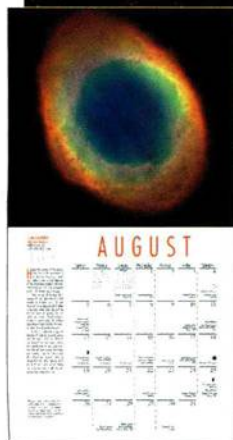
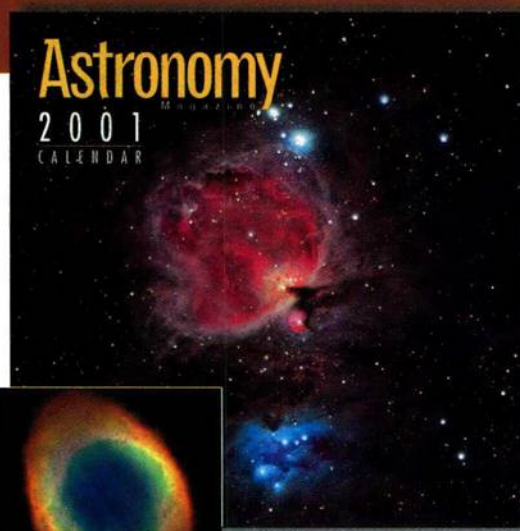
Huge Discount Catalog
5,000 Items \$10 (refundable)

Secure Card Purchases!



E-MAIL: ASTROPTX@ASTROPTX.COM
WWW.ASTROPTX.COM

Now available!



5665-0101

Astronomy Magazine's 2001 calendar is here! This stunning calendar displays the most spectacular celestial events of the year. Features fantastic photographs and artwork, information on viewing numerous celestial events, seasonal star charts and lists all major holidays throughout the year. Calendar measures 12"x12"; opens to 12"x 24".

68116 • \$12.95

Call 1-800-533-6644

Call Mon-Fri, 8:30am-5:00pm Central Time. Outside the U.S. and Canada, call 262-796-8776. Please have your credit card ready.

Fax 262-796-1615

Online www.kalmbachbooks.com

Secure online ordering available.

Mail Send your order to Kalmbach Publishing Co., Dept. A1841, 21027 Crossroads Circle, P.O. Box 986, Waukesha, WI 53187-0986. Include for shipping and handling:

Merchandise Total	Add for S & H
\$10.00 or less	\$3.95
\$10.01-30.00	\$4.95
\$30.01-50.00	\$5.95
\$50.01-75.00	\$6.95
over \$75.00	\$7.95

Canada add an additional \$2.00, other foreign add an additional \$5.00. For Wisconsin delivery, add 5% sales tax to total; Pennsylvania add 6% sales tax to total. For delivery in Canada add 7% GST to total. Payable in U.S. funds. Prices and availability subject to change.

A1841



A collection of your images and observations

EARTHSHINE

Shooting the Moon

► At the age of 13, I visited the Franklin Institute in Philadelphia with my father. I stood in awe at the magnificent images of the solar system and remember making frequent trips back to this room with only a passing interest in the other exhibits. I especially remember standing and staring at the large images of the moon, with all its craters and shadows.

The next year I joined an amateur telescope makers' club that held its meetings at the Franklin Institute. My goal was to learn how to grind and polish a mirror blank for my soon-to-be-built 6-inch Newtonian. During a break at one of the club meetings, I wandered outside the lab and opened a door to a room that had previously gone unnoticed by me. In the dim light of the darkened room I saw a strange photograph hanging on a wall. It was a lunar photograph different than any I had ever seen. To the mind of a 14-year-old boy, it seemed to be some sort of trick photography or anomaly. The image consisted of a bright banana-shaped edge that overpowered the rest of the picture. The remaining shadowy portion of the moon was slightly darker and lacked contrast, giving it an almost ghostly effect. I remember thinking how it would be nice to own a picture like that.

A couple years later while setting up my Newtonian, I looked toward the



Earthshine

CHARLES W. STONE

(12-inch SCT at f/6.3, Fuji Superia 400 film, 8-second exposure taken March 8, 2000, at 6:52 P.M. EST)

Lunar Craters Ptolemaeus, Alphonsus, and Arzachel

CRAIG ZERBE

(11-inch SCT, Astrovid 2000 video camera, taken September 20, 2000)

moon and, to my surprise, found myself staring at the same lunar phenomenon I had seen in the photograph at the Institute. Now all I had to do was learn how to photograph it.

On March 8, 2000, I was driving home from work and enjoying the clear late afternoon sky. I remembered that the just-past-new moon should be briefly visible tonight low in the western sky.

I have graduated from the 6-inch Newtonian that I built as a boy and am now using a permanently mounted 12-inch SCT. I live in an area surrounded by trees, houses, and a nearby water tower, so I dismissed the notion of being able to photograph this event from my small backyard observatory. But around 6:20 P.M. I wandered outside and looked up. There it was — crystal clear and unobstructed, for now.

I ran to open up my observatory. By the time I was set up and had rotated the dome, the elusive March crescent was hovering just above that accursed water tower. It wasn't quite dark enough for an exposure of more than a few seconds, so I did a quick focus and took a chance on an 8-second exposure. The time was 6:52 P.M., and I snapped the shutter. Within a few seconds the moon began disappearing behind the water tower. I was only able to make one exposure that evening but was very pleased with the results.

And now, after only 40 years, I finally have my own photograph of lunar earthshine.

A

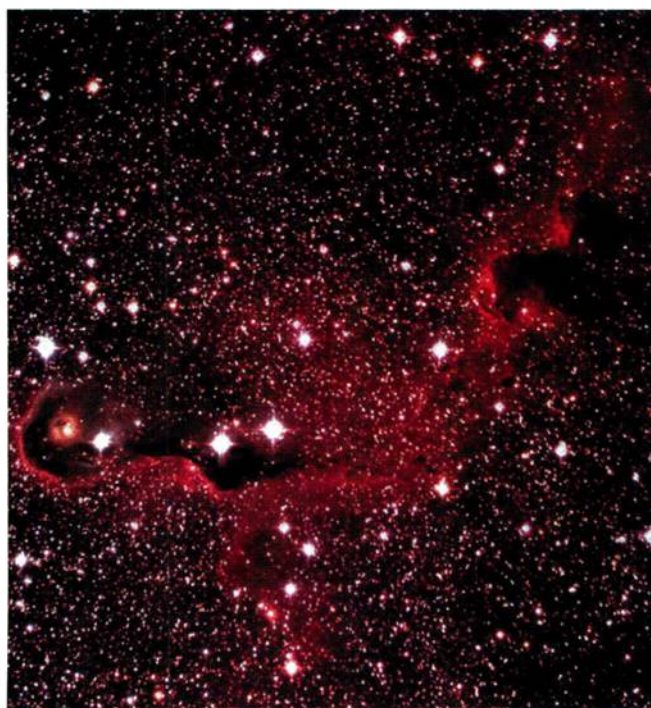
Charles W. Stone lives in Clayton, New Jersey.



The Cat's Paw Nebula (NGC 6334) in Scorpius

CHRIS COOK

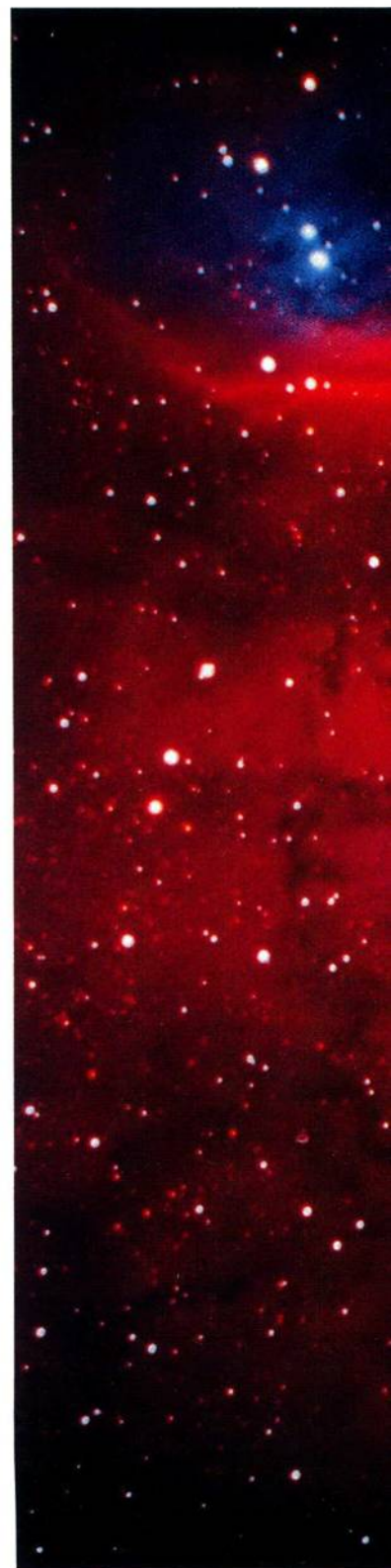
(85mm refractor at f/7, Kodak Pro 400 film, composite of two 50-minute exposures)



IC 1396 in Cepheus

BRIAN LULA

(20-inch reflector, IMG1001E CCD camera, 9-minute red, 9-minute green, 12-minute blue, and 10-minute luminance exposures)





NGC 6559 in Sagittarius

KEN BLANKENSHIP AND DENNIS BATIS

(14-inch SCT at f/7.5, Kodak PJ 400 film, composite of two
180-minute exposures)



Italian Sunset by the VLBI Antenna

FABRIZIO MELANDRI

(400mm lens at f/32, Fuji Velvia 50 film, $\frac{1}{2000}$ -second exposure every 4 minutes, $\frac{1}{15}$ -second exposure at f/11 after sunset, taken from Medicina, Italy)



Leonid Meteors

FABRIZIO MELANDRI

(24mm lens at f/2.5, Kodak Elite 400 film, 12-minute exposure taken November 18, 1999, from Pontremoli, Italy)





The Orion Nebula (M42)

DAVID HANON

(7-inch refractor at f/7, ST-8 CCD camera, composite of 14-minute red, 21-minute green, and 52.5-minute blue exposures)



This month's best astrophoto



Total Solar Eclipse Stages

BOB MINOR

(200mm lens at f/11, Kodak Gold 100 film, $\frac{1}{250}$ -second exposure for partial phases, $\frac{1}{4}$ -second exposure for totality, taken February 26, 1998)

The last total solar eclipse in the Western Hemisphere passed by a soccer field on the northwest coast of Curaçao, where this photo was taken. Mercury is captured between two of the eclipse stages, and Jupiter appears below totality.



AES Amateur Electronic Supply	123	New England Meteoritical	125
Adirondack Video Astronomy	85	New Mexico Skies	122
Adorama	116, 117	Newport Glass Works	124
Arcron Zeit	97	Novaspace	125
American Paper Optics, Inc.	124	Oceanside Photo & Telescope	85
Any Cosmic Night	124	Orion Telescopes & Binoculars ...	40, 41, 106, 107, 137
Astro-Physics	123	Outer Edge Expeditions	124
Astro Stuff	31	Pocono West Optics	95
Astronomics	54, 55	Rainbow Symphony	17
Astronomy Shoppe	85	Retail & Travel Directory	126
Atinatech	17	Rivers Camera Shop	97
Bethany Sciences	125	Rome Telescope Company	125
Camcor, Inc.	96	SCS Astro	122
Cavendish Press	61	Sac Imaging Systems	123
Celestron International	20, 21, 111	Santa Barbara Instrument Group	113
Celestron International Dealer Page	23	Science Art Co.	122
Davis Instruments	118	Science Connection, Inc.	123
Day Star	61	Scope City	136
Deharpporte Trading Co.	122	ScopeTronix	125
Discovery Telescopes, Inc.	118	Shutan Camera & Video	18, 119
Eagle Optics	121	Skytent International	109
Eclipse Edge	136	Star Hill Inn	123
Edmund Scientific Company	103	Star Tek Industries	125
Edward R Hamilton Bookseller	123	Starcom Worldwide	33
eHobbies.com, Inc.	34, 35	Starizona	61
F C Meichsner Company	31	Starry Night	29
Firefly Books Ltd.	19	Starsafaris.com	31, 115
Focus Camera	88, 89	Starsplitter Telescopes	122
Glatter, Howard	124	Swinburne University of Technology	27
Hands On Optics	125	T & T Binocular Mounts & Beyond LLC	124
Hardin Optical Co.	121, 124	Tech 2000	122
JMB, Inc.	61	Technical Innovations	85
Jim's Mobile Industries	100, 101	The Telescope Store	96
Kalmbach Publishing Co.	78, 79, 96,	Thousand Oaks Optical	103
.....	109, 115, 119, 127, 128, 135	Travel Wizard	122
Kendrick Astro Instruments	119	Vernonscope & Company	125
Le Sueur Manufacturing Co.	97	The Weather Warehouse	124
Light Speed Telescopes, Inc.	123	What in the World	31
Lumicon	104, 105	Wholesale Optics	128
Lymax Earth, Sky & Astronomy	122	Woodland Hills Photo Images	109
Mag One Instruments	124	Yale University Press	128
Marketplace Pages	122, 123, 124, 125		
Meade Instruments Corp.	2, 3, 7, 8, 9, 10, 11		
.....	12, 13, 25, 138		
Minerva Press	123		
Mountain Skies Astronomical Society	124		

NEXT month in Astronomy®



N. A. Sharp/AURA/NOAO/NSF

MONSTER BLACK HOLES

Which came first — galaxies or the supermassive black holes that lurk in their centers? New evidence hints that the galaxies we see grew from the inside out.

EYE THE CLOSEST GALAXY

A centerpiece of the southern sky, the Large Magellanic Cloud boasts hundreds of bright star clusters and eye-popping nebulae for backyard observers.

TURN ON THE LIGHT

With giant new telescopes at their disposal, astronomers can now see back to the time when stars and galaxies first flooded the universe with light.

TAKING THE HIGH ROAD

A trip to the mountaintop brings one amateur astronomer closer to nature and, more importantly, to the deep-sky objects he loves.

To get your copy of the February issue, visit your local hobby shop or newsstand, or call

1-800-533-6644

Kalmbach Publishing Co., P.O. Box 1612,
Waukesha, WI 53187-1612

Visit our web site at

www.astronomy.com

Africa Eclipse Expedition

Join Eclipse Edge Expeditions June 14-22, 2001 as we explore Victoria Falls, Zimbabwe. Itinerary includes animal safari and best view of the total solar eclipse -- from near the path edge, where more and longer totality phenomena are seen.



Run by professional astronomers; our experienced team has selected sites to maximize weather prospects and will have mobility available if needed. Astronomy program includes southern sky observing. Optional activities include white water rafting, bungee jumping, elephant ride; and tethered balloon or helicopter view of the falls.



From \$1750

short program originating
in Johannesburg

To \$3900

full program, air from
Washington, DC

Eclipse Edge Expeditions 'Z01
P.O. Box 15186
Chevy Chase, MD 20825-5186
800-898-3343 (recording)
<http://metaaresearch.org/edge>

International Dark-Sky Association



*Promoting efficient lighting to
reduce glare, to conserve
energy, and to preserve the beauty
of our night skies*

To learn about *light pollution*, *energy
waste*, *light trespass*, and related issues,
or to join, (\$30 basic membership),
call or write to the non-profit

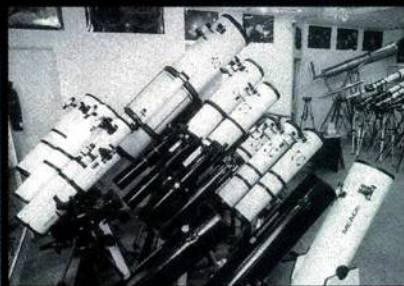
International Dark-Sky Association,

3225 N. First Avenue
Tucson, AZ 85719-2103

(520) 293-3198

(520) 293-3192 (fax)

<http://www.darksky.org>



You've never seen anything like it!

Experience the Largest, Most Complete Optical Supermarket in the World.



Scope City Locations / Showrooms

SIMI VALLEY, CA: 730 Easy Street, (805) 522-6646

SHERMAN OAKS, CA: 14324 Ventura Blvd., (818) 789-5805

COSTA MESA, CA: 3033 S. Bristol, (714) 957-6900

SAN DIEGO, CA: 4766 Clairemont Mesa Blvd., (858) 277-6686

LAS VEGAS, NV: 4825 W. Flamingo Rd., (702) 947-2673

SAN FRANCISCO, CA: 350 Bay Street, (415) 421-8800

Save up to 45%

**All Major Brands
at discount prices**

Buy
Sell
Trade
Service

MAIN OFFICE: 730 Easy Street,
Simi Valley, CA 93065, (805) 522-6646

Scope City / Mail Order
P.O. Box 440, Simi Valley, CA 93062

TEL: (805) 522-6670

www.scopecity.com

telescope.com

Different Scopes for Different Folks

How To Choose the Right One.

Forget about "power." It's *diameter* that counts.

1 A telescope's most important feature is not its magnifying power, but rather its *light-gathering ability*, determined by the diameter of the main lens or mirror. The more light gathered, the more you'll see. Telescopes advertised on the basis of high magnification ("450x!") are virtually always of inferior quality. Power is adjusted by changing eyepieces, and lower powers provide brighter, sharper images.



A 6" mirror/lens is 2-1/2 times the diameter of a 60mm mirror/lens, yet it gathers nearly 5-1/2 times more light!

Refractor, Reflector, or Cassegrain?

2 The different types of telescope all do the same thing: they collect and focus light. A *refractor* does it with a multi-element lens, while a *reflector* uses a concave mirror. A *Cassegrain-type* telescope employs both mirrors and lenses.

Reflector telescopes are designed exclusively for astronomy. They deliver more light-gathering power for the money than other telescope types, but they render an upside-down image that's unsuitable for terrestrial observing.

Refractors or Cassegrains work well for both astronomical and earthly viewing. Refractors provide terrific image quality but get quite expensive in larger sizes compared to reflectors. Cassegrains are pricey too.



May We Suggest...

Inexpensive Telescopes for Kids (& Grown Ups)

Simple altazimuth mounts and sizes that won't overwhelm make these great telescopes for kids from 8 to, well, 88.



Compact, Portable Telescopes

If you have a low tolerance for "lugging," or are tight on storage space, then you will appreciate these compact but very capable telescopes.

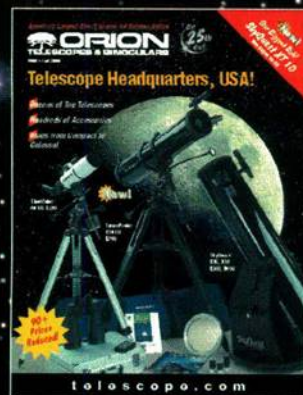


All-Purpose Astro Scopes

Reflectors in this size range perform admirably on all types of astronomical subjects, from the Moon



- ▶ 1000+ telescopes, binoculars, & accessories
- ▶ New product updates
- ▶ Web-only specials
- ▶ Learning center
- ▶ Telescope buyer's guide



FREE 100-Page Catalog!
(800) 447-1001 or
request it online

Our
25th
Year!

ORION
TELESCOPES & BINOCULARS

Everything for the Amateur Astronomer—Delivered Direct



Images with the Meade 10" LX200 Schmidt-Cassegrain telescope by Philip Perkins of Wiltshire, England. *Clockwise from upper-left: The Rosette Nebula (NGC 2237) in Monoceros; the Flame Nebula (NGC 2024) in Orion; Spiral Galaxy (M100) in Coma Berenices; Spiral Galaxy (M81) in Ursa Major.* Comments Mr. Perkins: "I believe that my astrophotographs genuinely represent what the typical user may achieve with the 10" LX200...my LX200 has not been modified in any way; I use it just the way Meade manufactured it, and I think the results speak for themselves. The telescope's optics, stability, and tracking accuracy are fully up to the demands that my photographic program requires."

The largest-selling telescopes in the world.



ADVANCED PRODUCTS DIVISION

Meade Instruments Corporation

6001 Oak Canyon, Irvine, California 92618 ■ (949) 451-1450

FAX: (949) 451-1460 ■ www.meade.com

© 2000

